Installation and Service Manual

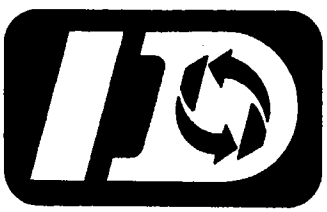
BDS2/1 Series
Brushless Motor Controller

M-8408 - Issue 3

Caution:

Dangerous voltages exist in this equipment. Do not attempt connecting or probing in this equipment with power on.

Should any question arise regarding any step outlined in this manual please call the factory.



INDUSTRIAL DRIVES
A
KOLLMORGEN
DIVISION

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PREFACE

This Installation and Service Manual is a general document and is applicable to the entire BDS2/1 series product line. However, since these motor controllers are interfaced with motors of varying sizes having different operating characteristics such as internal resistance, inductance, rotor inertia, etc., the complete model number of these amplifiers will vary more or less with the motors they are made compatible with. Thus, after an amplifier and a particular motor are connected together to form a complete Rate Loop system, the model number applied to the amplifier nameplate is in reality the model number for the system. However, the PSR1 Main Bus power supply will have a nameplate bearing its specific Model Number.

The Test Limits and Modification Sheet (TL) is a specific document and is applicable only to individual systems. The TL Sheet contains such information as maximum operating speed, peak current limits, and the component compensation values which make the amplifier motor combination compatible.

MODEL NUMBER SYSTEM

EXAMPLE: BDS2/1-208/25-01-100-4501AXX
A B C D E F

BDS2 -. . . . . Brushless Drive Sine Wave Controller

A -/1 . . . . . Number of Axes

B - 208 . . . . . Output L-L RMS Voltage

C - 25,40,60,75,90,130. . Output RMS Current per Phase

D - . . . . . Mechanical Configuration

01 . . . . . Panel Mount w/o DB Contactor
03 . . . . . Panel Mount w/DB Contactor

11 . . . . . High Powered Panel Mount w/o DB Contactor

21 . . . . . Panel Mount w/Cold Plate
(Check with Factory For Combinations of Current Ratings and Panel Configurations)

E -

100 . . . . . No Option

101 . . . . . Connector Kit w/Insulation Displacement Terminal

102 . . . . . Connector Kit w/Crimp Terminal

103 . . . . . Screw Terminal Strips

F - . . . . . Motor Compensation

MODEL NUMBER SYSTEM

EXAMPLE: PSR1-208/040-01
A B C

PSR1-	. . . . .	Power Supply and Regen. Module for BDS and VFS Systems
A-	208	Amplifier L - L RMS Voltage when using this Power Supply
B-	040, 100	DC Output Current, 40A,100A
C-	. . . . .	Regen. Capability
	01	4.5 Ohm 1000W Fused for 30/40A

EXAMPLE: PSR1-230/130-01
A B C

PSR1 -	. . . . .	Power Supply and Regen. Module for BDS and VFS Systems
A	-	Amplifier L-L RMS Voltage when using this Power Supply
B	- 130	AC RMS Input Current, 130 A RMS
C	-	Regen. Capability
	01	2.25 Ohm 2000 W (2 Parallel 4.5, 1000 W). Fused for 60 A.

1.0 DESCRIPTION

The Industrial Drives Division BDS2/1 product lines are sinewave brushless D. C. motor controllers. They are fully regenerative four-quadrant bi-directional velocity loop amplifiers designed to be used with Industrial Drives high performance brushless D. C. motors.

The D. C. brushless motor consists of a six-pole rare-earth permanent magnet rotor and a three-phase Y connected stator winding. Being a brushless motor, there is no commutator or associated brushes. The motor is run as a synchronous motor, meaning that the rotor speed is the same as the speed or frequency, of the rotating stator magnetic field. A brushless tach and a resolver are utilized as feedback devices and are mounted internally as part of the overall motor construction.

An unregulated 300/325V DC bus, derived from full-wave rectification of a three-phase 208/230 AC line by the PSR1 Power Supply unit, is used to power the BDS2/1 motor controller. A shunt regulator, or "regen" module located within the PSR1 unit, is used to prevent the bus from being "pumped up" during periods of regeneration.

Benefits resulting from the BDS2/1 and brushless motor construction are:

(1) Lower rotor inertia permits higher acceleration rates.

(2) The motor is thermally more efficient since all heat is generated in the stator windings which are located in the outside shell of the motor.

(3) Higher speed operation and high peak horsepower are achieved since there is no commutation limit.

(4) Smaller physical motor size for a given H.P. rating.

(5) Higher reliability and less motor maintenance since there is no commutator or brushes.

(6) Smooth output torque even at very low speeds due to sinusoidal current control. There are no torque pulsations at low speeds.

(7) Minimized motor heating due to the absence of harmonics which are normally associated with "stepping" waveforms.

(8) The BDS2/1 sine-wave controller allows for a wider speed range because of the ability to electronically change the angle between the rotor flux and the stator flux--commonly known as the "torque angle."*

(9) The BDS2/1 sine-wave controller has the capability to dynamically and adaptively change the torque angle as a function of speed and load, thus allowing the system to operate at the most efficient operating point.

1.1 Ratings

PSR1 RATINGS

MODEL NO.	INPUT VOLTAGE L-L RMS	OUTPUT CURRENT CONTINUOUS DC	OUTPUT VOLTAGE DC
PSR1-208/040	208V AC	40A	300V
PSR1-208/100	208V AC	100A	300V
PSR1-230/130	230V AC	130A	325V

BDS2/1 RATINGS

MODEL NO.	OUTPUT RMS/PHASE CONTINUOUS	CURRENT RMS/PHASE PEAK	OUTPUT VOLTAGE RMS/PHASE NO LOAD
BDS2/1-208/25	25A	50A	200V
BDS2/1-208/40	40A	70A	200V
BDS2/1-208/60	60A	105A	200V
BDS2/1-208/75	75A	105A	200V
BDS2/1-208/90	90A	105A	200V
BDS2/1-208/130	130A	185A	200V

*INDUSTRIAL DRIVES DIVISION KOLLMORGEN CORPORATION Patent Numbers 4447771 and 4490661

In an improved motor control system for a pulse width modulated synchronous brushless motor, means for adaptively controlling the "torque angle", i.e. the angle between the rotating magnetic field created by the permanent magnets on the rotor, is provided. The relationship between the two magnetic fields is controlled as a function of load and speed to provide the optimum operating point at all times. Controlling the torque angle effectively varies the back EMF constant K_e (V/RPM), and the torque constant K_+(torque/ampre) of the motor.

1.2 Standard Features:

Packaged for ease and quickness of service using built-in diagnostic features.

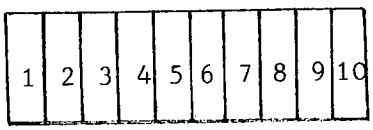
Accurate digital control of motor dynamics achieved through Industrial Drive Division's SELF-SYNCHRONOUS motor control concept.

Improved dynamic response due to wide-band current loop utilizing isolated feedback for increased personnel and equipment safety.

Smooth operation down to zero speed.

1.3 Self Protection

The BDS2/1 amplifiers are fully protected against a variety of fault conditions for a high degree of reliability. Fault modes are identified by a diagnostic bar-graph indicator (274) as shown below:



1. POWER LOSS (Control Bus)
2. OVERTEMP (Heat Sink Thermostat)
3. OVERSPEED (Excessive Speed Shutdown)
4. REGEN (Excessive/Loss: Main Bus)
5. REMOTE INHIBIT
6. FOLDBACK (Peak Current)
7. DIRECTION LIMIT
8. OPTION (Fault)
9. NOT USED
10. NOT USED

2.0 MOUNTING (Refer to the appropriate Outline and Dimension Drawing)

It is recommended that the BDS2 and PSR1 units be mounted in their horizontal up-right positions.

CAUTION: Allow sufficient clearance for the large "regenerative" heat producing resistor mounted at the upper edge of the PSR1 unit.

It is recommended that the BDS2/1 not be mounted behind the front center sections of the cabinets, otherwise, the amplifiers "swingout" unit will be blocked and access to its internal area will be restricted.

3.0 WIRING (Refer to the appropriate System Wiring Diagram and Fig. 1, 2, 3, 4. and 5.)

IN ORDER TO ADHERE TO SUITABLE ENGINEERING PRACTICES, IT IS RECOMMENDED THAT THE CONTROL VOLTAGE BE APPLIED FIRST IN ORDER TO ACTIVATE THE CONTROL AND FAULT CIRCUITS BEFORE APPLYING THE MAIN BUS VOLTAGE.

There are two package configurations. The first of which the control interface wiring is brought directly to Connectors 180 and 233 of the Large Motor Control Card (BDS2-MC2). (Standard) See Figure 1, C-80252 and C-80426.

The second configuration of which the control interface wiring is brought to terminal blocks mounted on the end (side) of the package. (103 series). See Figure 2 and C-80716.

Reference to the NOTES on the appropriate System Wiring Diagram will aid in correctly "wiring the system up."

The following precautions are recommended:

1. Twist all AC leads to minimize electromagnetic emissions and pick-up.

2. Avoid running signal leads in close proximity to power leads, armature leads, or other sources of electromagnetic noise.

3. Minimize lead lengths as much as practical.

4. Double-check all wiring. Carefully inspect all connections.

5. DO NOT USE MAIN CONTACTOR FOR CONTROL FUNCTIONS.

IMPORTANT: Motor, Tachometer, and Resolver phasing are critical for proper operation.

3.1 Grounding Scheme (Refer to the appropriate System Wiring Diagram and Fig. 3.)

It is recommended that the motor be grounded at the AMPLIFIER CHASSIS GND stud. The BDS2/1 AMPLIFIER GND stud should then be grounded at Earth or Machine ground.

3.2 Signal Inputs and Modes of Operation

The following descriptions are given to help the user decide what inputs and modes of operation to incorporate into the overall system and to identify the appropriate connecting points.

The External Current Limit may be utilized, when external control of motor torque is desired, by opening a contact between Pins 8 and 16 of Connector 233 or Points 8 and 11 of TB2. Refer to the T.L. Sheet for reduced current limit value.

The Direction Limits may be utilized when it becomes necessary to restrict the movement of a slide, etc. in a given direction while allowing movement in the opposite direction.

When a limit switch is contacted and opened between Pins 11 or 12 with respect to 16 of Connector 233, or Points 9 or 10 with respect to 11 of TB2, movement is restricted beyond the limit switch contacted, while allowing movement off of the limit switch in the opposite direction. Movement in the opposite direction will be restricted when the other limit switch is contacted and opened.

The Remote Inhibit allows a means by which the amplifier may be disabled without removing the main power. When a contact is closed between Pins 10 and 16 of Connector 233 or between Points 5 and 11 of TB2, the amplifier will be put into the "Drive-Up" mode. Opening the contact will "Inhibit" the amplifier.

The "Drive-Up" contact closure (internally) is provided at Pins 3 and 4 of Connector 233 or Points 3 and 4 of TB2, and when closed is an indication to the outside world (software, etc.) that the amplifier is in its "Drive-Up" mode; or when open is an indication that it is in the Inhibit mode. These contacts are rated at 115V AC at 2 amps.

The Torque Hold mode of operation can be utilized when the motor is required to dwell against hard stops or operate in a tension control system. Opening a contact between Pins 6 and 16 of Connector 233 or Points 7 and 11 of TB2 will convert the amplifier from a constant velocity to a constant torque system.

The Input Reference Signal (not to exceed ±10 volts) is applied to the amplifier at Pin 5 with respect to 7 of Connector 233 or Point 1 with respect to 2 of TB2.

Signal and Shield Commons are provided at Pins 16, 17, 19, 20 of Connector 233 or points 11 and 12 of TB2 providing adequate points without overloading pins or terminal points.

The Velocity Output signal may be monitored at TB2-13 with respect to TB2-12. (103 Series Only) There is a direct relationship between this voltage level, and the actual motor speed in R.P.M. Refer to the T.L. Sheet for Scale Factor in Volts/R.P.M. (Refer to section 8.0)

4.0 PRELIMINARY CHECKS (Refer to the appropriate System Wiring Diagram)

Once the BDS2/1 system has been installed and wired in, continue with the Preliminary Check-Out procedure to ensure proper operation before the Main Power is applied.

The initial start-up should be done with the load and control command disconnected. (Disable the N/C, if necessary, to prevent automatic shutdown.) The following equipment will be required:

1. Adjustable Signal Source 0-±10V DC at 10ma.
2. Multimeter
3. Oscilloscope (4 Channel)

4.1 Checking the Power Input

Open the circuit breaker on the PSR1 Power Supply. Apply power to the primary of the large input isolation transformer.

The 3 phase secondary line-to-line voltage should be either approximately 208 or 230V RMS (depending on PSR1 Model) ±10% at the line side of the PSR1 Circuit Breaker. If the voltage is above or below the rated voltage by more than 10%, please select another transformer tap.

4.2 Checking the PSR1 Output

Remove the main power. Remove the D. C. bus leads at 4 and 5 of the Power Terminal Block on the BDS2/1. Monitor the lead formerly connected to terminal 4 with respect to the lead formerly connected to terminal 5. Apply the main power. This voltage should be approximately 300/325V DC (depending on PSR1 Model). Open the circuit breaker. CAUTION: Wait 3 minutes for large Power Supply capacitors to discharge. Reconnect the D.C. bus wires to the Power Terminal Block on the BDS2/1 so that terminal 4 remains positive with respect to 5.

4.3 Checking the Brushless Motor Phasing (Refer to Figure 4 and 5)

The motor should be connected to the amplifier so that a phase sequence of ACB will result in a CW direction of rotation as viewed from the large shaft end. (Refer to the appropriate System Wiring Diagram.)

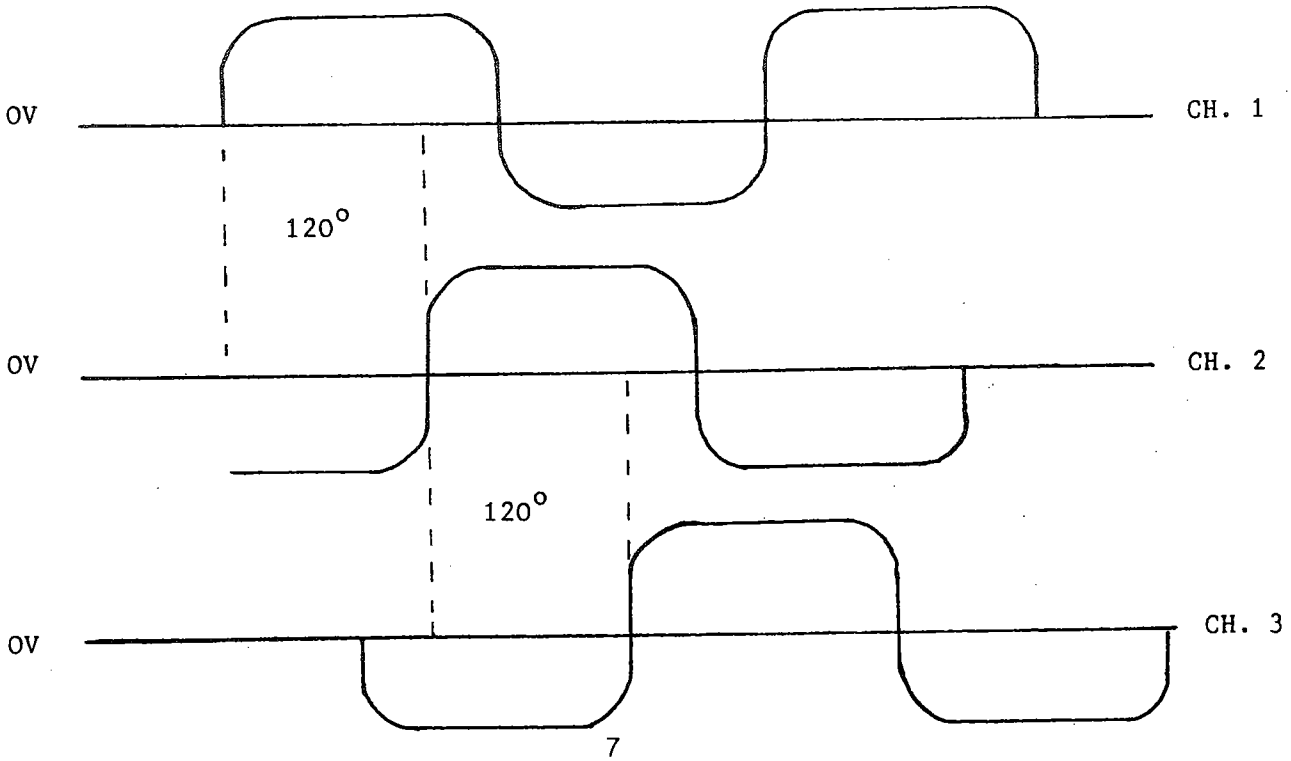
If the motor stator is wired according to the System Wiring Diagram, the phase sequence will automatically be correct. However, the following procedure is given in order (for those wishing to do so) to check the motor phasing.

Remove power. Connect one end of a 1k resistor to terminals 1, 2, and 3 of the BDS2/1 power terminal block with the motor stator leads connected. Connect the free ends of the 1k resistors together to form a simulated three phase neutral.

With an oscilloscope, monitor the motor stator leads, with respect to the neutral of the resistors, in the following manner:

CHANNEL 1 to TB-1
CHANNEL 2 to TB-3
CHANNEL 3 to TB-2

Have a colleague rotate the motor shaft clockwise as viewed from the large shaft end. The waveforms should appear as shown below. Remove the resistors.



4.4 Checking the Resolver Phasing

If the resolver is wired according to the appropriate System Wiring Diagram, the phase sequence will automatically be correct. However, the following procedure is given in order (for those wishing to do so) to check the resolver phasing.

Open the PSR1 circuit breaker.

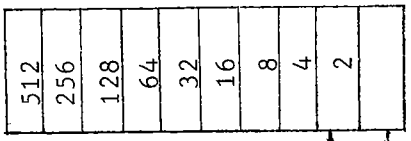
Apply only the 115V AC control power. Have a colleague rotate the motor shaft clockwise (as viewed form the large shaft end) while observing Bar Graph 277 on the BDS2-MC2 Motor Control Card. (See Fig.1) Rotate the motor shaft until all sections of the Bar Graph go out. Using this indication as a starting point, begin slowly turning the motor shaft C.W. As the counter counts up, the first bit on the right should come on and remain on during C. W. rotation of the motor shaft. This is the direction bit. The second bit on the right represents the BCD number 2 (1 is not displayed on the Bar Graph). As the motor shaft is rotated C. W., the sections of the Bar Graph should continue to illuminate from right to left as the counter counts up until all sections are illuminated.

CAUTION:

The direction bit L.E.D. at the extreme right hand side of Bar Graph 277 must be illuminated for clockwise rotation only, as viewed from the large shaft end. Otherwise the motor may run away on power up.

Rotate the motor shaft until all sections of the Bar Graph are illuminated. Using this display as a starting point, begin slowly turning the motor shaft counterclockwise as viewed from the large shaft end. The first bit on the right should go out and remain out during C.C.W. rotation of the motor shaft. This is the direction bit. The second bit on the right represents the BCD number 2 (1 is not displayed). As the motor shaft is rotated CCW, the sections of the Bar Graph should continue to go out. The illuminated sections should now move from left to right as the counter counts down. At the end of one complete revolution, all sections should be out. The LSB is the second indicator on the right end of the Bar Graph.

One mechanical revolution of the motor shaft (360°) equals 1024 counts as indicated by the Bar Graph as shown below. (the 1 count is not displayed.) Remove the 115V AC control power.



Direction Bit Must Be Illuminated for CW Rotation of Motor Shaft As Viewed From The Large Shaft End

4.5 Zeroing the System (Motor) Resolver

WARNING!

DO NOT DISTURB THE (SYSTEM) (MOTOR) RESOLVER!

CAUTION!

DO NOT MISTAKE THE SYSTEM (MOTOR) RESOLVER FOR THE APPLICATION (POSITION LOOP) RESOLVER

The SYSTEM (motor) resolver has to do only with the Industrial Drives BDS2/1 Velocity Loop Motor Controller.

This resolver has been factory set at its ZERO POINT and should never require adjustment. However, the following procedure is given in the event of resolver replacement or in the event the resolver is unintentionally moved off of its zero setting. See Figure 4 and 5.

To set the Industrial Drives SYSTEM (motor) resolver to its zero point, do the following:

1. Remove the 115V AC control voltage. Open the PSR1 circuit breaker.

2. Connect the adjustable (manual) signal source to the input of the BDS2/1 and set for 0 volts in.

3. Open the REMOTE INHIBIT and TORQUE HOLD circuits.

4. Temporarily place a jumper from TP188 to TP190 on the BDS2-MC2 Motor Control Card. (See Figure 1)

5. Remove the motor stator lead from point 1 of the BDS2/1 power terminal block and temporarily tape its end up.

6. Remove the rear end bell cover from the motor to allow access to the resolver cavity. Refer to Figure 4.

7. Locate the black 0.12 in. long reference mark stamped on the motor shaft between the tachometer and the motor gear. Rotate the motor shaft so that the reference mark is positioned facing the motor I/O port. Refer to Figure 4.

8. Loosen the motor gear clamp to allow the entire gear train to be turned independent of motor shaft position.

9. Apply the 115V AC power and close the PSR1 circuit breaker. Close the INHIBIT circuit to enable the BDS2/1. Leave the "Torque Hold" Circuit Open.

10. Apply small amount of input signal so that TP18 on the Comp 3 Card is negative (-)1.0 volt. Rotate the motor shaft to locate the nearest zero torque point. It should be very near the point where the motor shaft orientation places the reference mark facing the motor I/O port.

11. With the reference mark on the motor shaft facing the motor I/O port, secure the shaft at the center of the low torque point and rotate the motor gear (DO NOT MOVE THE SHAFT) until all L.E.D.'s are illuminated on the Bar Graph 277. Tighten the motor gear clamp. Recheck that all L.E.D.'s are still on. This is the resolver zero point.

12. Remove power. Replace the motor end bell cover. Reconnect the motor stator lead to point 1 of the power terminal block. Remove all jumpers. Close the TORQUE HOLD circuit.

HINT: There are three points located 120 mechanical degrees apart where the motor torque goes to minimum. The point where the reference mark on the motor shaft faces the motor I/O port is the only one to which the motor system resolver may be zeroed for proper operation.

If rotating the motor shaft by hand is difficult, apply less input signal. If the motor torque

"dead point" cannot be felt, increase input signal. IMPORTANT: Input signal must always make TP18 on Comp 3 Card NEGATIVE for proper operation. (See Figure 1)

4.6 Brushless Tach Phasing

If the brushless tach is wired according to the appropriate System Wiring Diagram, the phase sequence will automatically be correct. However, the following procedure is given in order (for those wishing to do so) to check the tachometer phasing.

The motor system resolver must be properly zeroed before checking tachometer phasing. Refer to Section 4.5.

To check the tach phasing, do the following:

1. Remove power. Connect the adjustable (manual) signal source to the input of the BDS2/1 and set for 0 volts in.

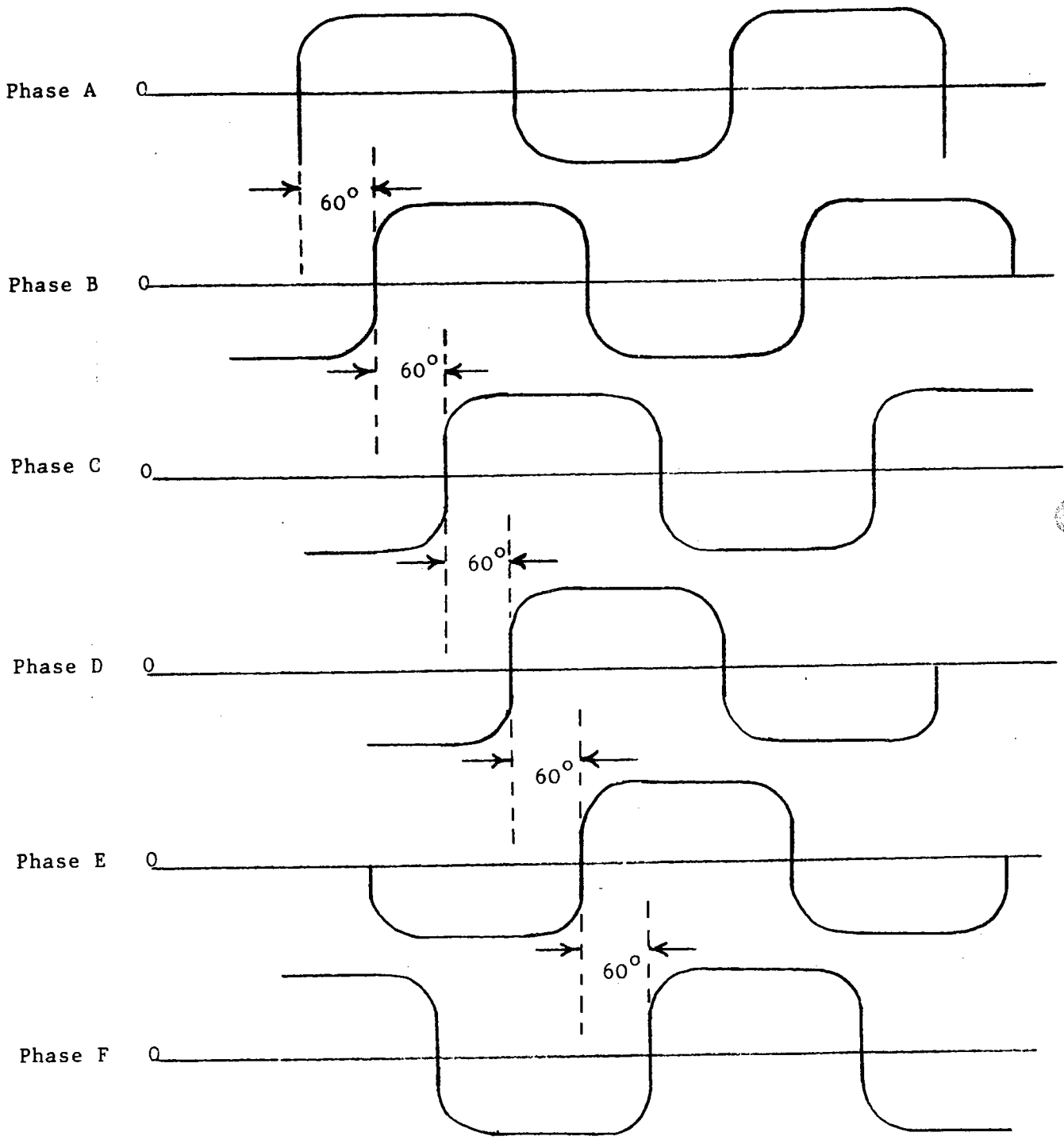
2. With an oscilloscope, monitor TP9 on the Comp 3 Card. Open the TORQUE HOLD circuit. Apply power.

3. Enable the BDS2/1. Place a command voltage at the input so that the motor turns CW at approximately 100 RPM. The correct scope trace should be POSITIVE at a smooth D.C. level. If not, proceed to step 4.

4. With Channel 1 of the oscilloscope, monitor TP264B on the BDS2-MC2 Motor Control Card. With channel 2, monitor "B" phase of the tach at TP181A. (See Figure 1) Run the motor slowly CW and check that the signals are 180 degrees out of phase as shown below.

   If the waveforms are not as shown REMOVE POWER and loosen the two screws holding the tach stator in place. Rotate the stator and tighten the screws. Apply power and recheck waveforms. Repeat this procedure until waveforms are as shown below. CAUTION: DO NOT PUT HANDS IN MOTOR WITH POWER ON.

5. With motor rotating CW, check that the tach phasing is as shown below. If phasing is not as shown, tach is connected incorrectly, either at amplifier or in the motor. Correct tach wiring error.



6. Recheck TP9 on the Comp 3 Card to verify that the tach signal is now a smooth, POSITIVE D. C. voltage for CW rotation.

4.7 Final Check-Out Before Connecting Motor to Load

Perform the final check-Out in the following manner:

1. Connect the adjustable (manual) signal source to the input of the BDS2/1 and set for 0 volts in.

2. Apply power. Enable BDS2/1 and close the TORQUE HOLD circuit. Using the adjustable DC signal source, and starting with a small input signal, apply a command to the input of the amplifier. Run the motor first in one direction, then the other. Have an assistant help observe the operation of the motor. The motor should accelerate and decelerate with quick crisp response and run with constant speed for any given input signal level. Gradually increase speed while exercising the motor until maximum speed is obtained. Adjust the Scale Factor Pot 22 on the Comp 3 Card CW to increase speed if necessary. (See Figure 1)

   DO NOT RUN THE MOTOR IN EXCESS OF THE MAXIMUM SPEED SPECIFIED BY THE TL SHEET FOR THE SYSTEM.

3. Command zero speed. Adjust Scale Factor Pot 22 on the Comp 3 Card fully CCW. (See Figure 1) Apply input signal equal to the amount that the N/C normally delivers for maximum motor speed. Adjust Pot 22 on the Comp 3 Card CW for the same maximum speed. Command zero speed from the input source.

5.0 CONNECTING THE N/C OR C/N/C

Remove the power. Remove the DC signal source and connect the Control input signal. Connect the load to the motor shaft.

CAUTION: INCORRECT SERVO TO POSITION LOOP PHASING CAN CAUSE LARGE EXCURSION OSCILLATIONS OR RUNAWAYS.

Appropriate precautions should be taken to stop the machine, if necessary. Slides, etc. should be moved a reasonable distance away from hard stops before applying power.

Apply power, enable the BDS2/1 and observe the action of the machine. If it is determined that the direction of rotation of the IDD motor is reversed, or runs in the wrong direction, remove power and remove jumper JR27 and install jumper JR26 on the Comp 3 card. (See Figure 1)

6.0 FINAL ADJUSTMENTS (Refer to Figure 1)

With exception to the Speed Scale Factor Pot (22) the AC Gain Pot (23), the Overspeed Pot (33) and the Velocity Loop Zero Pot (114) the adjustments are factory set and sealed and should not require adjustment. The following procedures are given only in the event of component or card replacement or in the event the seals are unintentionally broken. Reseal all pots after adjustment.

WARNING: DO NOT ADJUST THE CURRENT FEEDBACK GAIN POTS LOCATED ON THE HALL EFFECT CARDS. THESE ARE FACTORY SET AND SEALED ADJUSTMENTS ONLY. IF A SEAL IS EVER BROKEN, RETURN THE HALL EFFECT CARD TO THE FACTORY FOR ALIGNMENT OR ORDER A REPLACEMENT CARD. (See Figure 2)

6.1 Power Supply Adjustments

With a DC voltmeter, monitor the +15 volt test point TP13 (with respect to TP13A) on the Motor Control Card. Adjust Pot 5 for +15 volts $\pm$0.1V. Monitor the -15 volt test point TP23. Adjust Pot 15 for -15 volts $\pm$0.1 volts.

6.2 Regen Level and Overvolts Adjustments (Located on PSR1)

Monitor TP27 on the ACS-REG2 module with a DC voltmeter. Adjust Pot 19 for +8.25 volts. With D.C. voltmeter, monitor TP4, and adjust Pot 20 for +6.1 volts. (If ACS-REG1, C-79668-1 monitor TP30 and adjust Pot 27 for +8.25 volts. Monitor TP38 and adjust Pot 26 for +6.1 volts.)

6.3 Speed Scale Factor Adjustment (With N/C or C/N/C)

Monitor the "INPUT HI" with respect to "INPUT LO" with a D.C. voltmeter. (Refer to the appropriate System Wiring Diagram).

Command maximum traverse speed from the N/C or C/N/C. Adjust the Speed Scale Factor Pot 22, located on the Comp 3 Card, to obtain the input voltage level which the Control normally delivers at maximum speed. DO NOT EXCEED THE MOTORS MAXIMUM RATED SPEED.

If the "Following Error" is displayed by way of readout, simply adjust the Speed Scale Factor Pot for the proper amount of "Following Error" at any commanded speed.

6.4 Speed Scale Factor Adjustment (Manually Operated)

Monitor the "INPUT HI" with respect to "INPUT LO" with a DC voltmeter. (Refer to the appropriate System Wiring Diagram.)

Turn Pot 22, located on the Comp 3 Card, fully CCW. Apply command input signal of the desired voltage level (4 to 10 volts) which represents maximum traverse speed. Adjust the Speed Scale Factor Pot 22 CW for desired maximum speed. DO NOT EXCEED THE MOTORS MAXIMUM RATED SPEED.

6.5 Velocity Loop Zero Adjustment

For N/C or C/N/C machines:

If the "Following Error" is displayed by way of readout, simply adjust the Zero Pot 114 (located on the Motor Control Card) for zero "Following Error" at zero speed.

Optional: Monitor "INPUT HI" with respect to "INPUT LO" with a DC voltmeter. Command zero speed from the N/C or C/N/C. Adjust the Zero Pot 114 for zero volts on the meter.

For Manually Operated Machines:

With the input signal at zero volts, simply adjust Pot 114 for zero speed.

6.6 A.C. Gain Adjustment

In many cases, Pot 23 (located on the Comp 3 Card) may be turned fully CCW and disregarded. However, if necessary, the AC Gain Pot can be used to improve the dynamic response of the servo loop. To increase the AC Gain, monitor the brushless tach signal at TP9 on the Comp 3 Card. Apply a step input command and while accelerating and decelerating the motor at approximately 25% of maximum speed. Adjust the AC Gain Pot 23 CW and watch for indications of instability in the tach waveform. Turn Pot 23 back CCW until the tendency to go unstable diminishes.

CAUTION: INCREASING THE AC GAIN TOO MUCH MAY CAUSE THE SYSTEM TO GO UNSTABLE.

6.7 Current Foldback Zero Adjustment

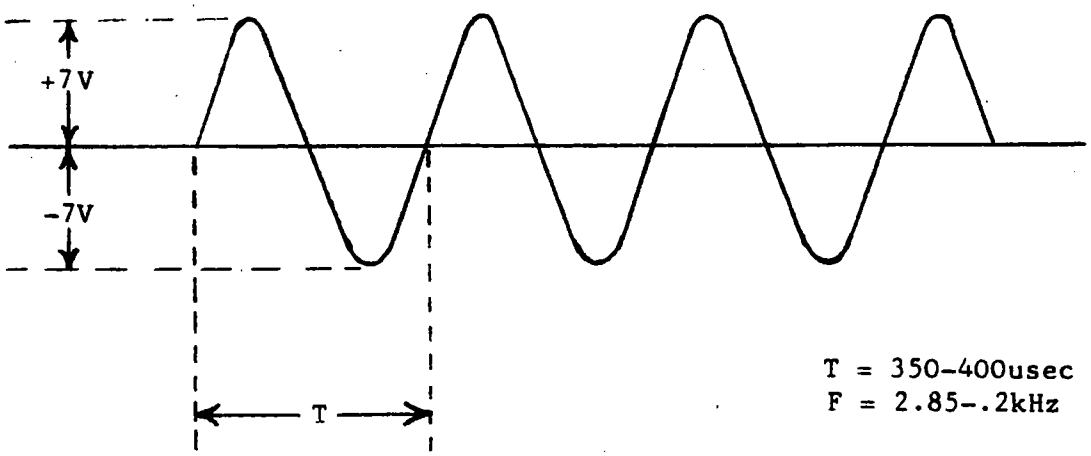
Inhibit the BDS2/1. Open the PSR1 circuit breaker. Place a jumper from TP55 to TP13A. Monitor TP193 with a DC voltmeter. Adjust Pot 216, located on the Motor Control Card, for zero volts at TP193. Remove jumper.

6.8 Overspeed Adjustment

Turn Overspeed Pot 33, located on the Comp 3 Card, fully CW. Run the motor at maximum speed. DO NOT EXCEED THE MAXIMUM SPEED SPECIFIED BY THE TL SHEET. Adjust Pot 33 slowly CCW until the system just shuts down. Adjust Pot 33 back 1 1/2 turns CW.

6.9 R/D Oscillator Adjustment

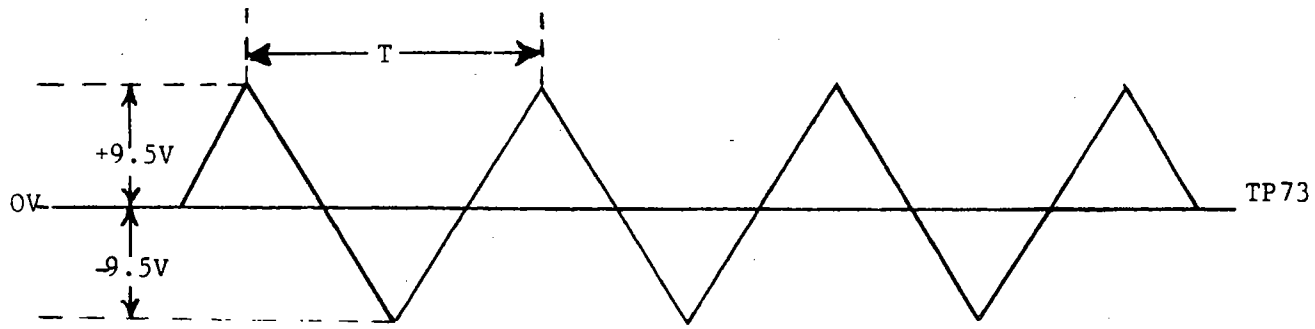
Inhibit the BDS2/1. Open the PSR1 circuit breaker. Monitor TP52 on Motor Control Card with an oscilloscope. Adjust Pot 62 for a 7 volt peak sinewave as shown below.



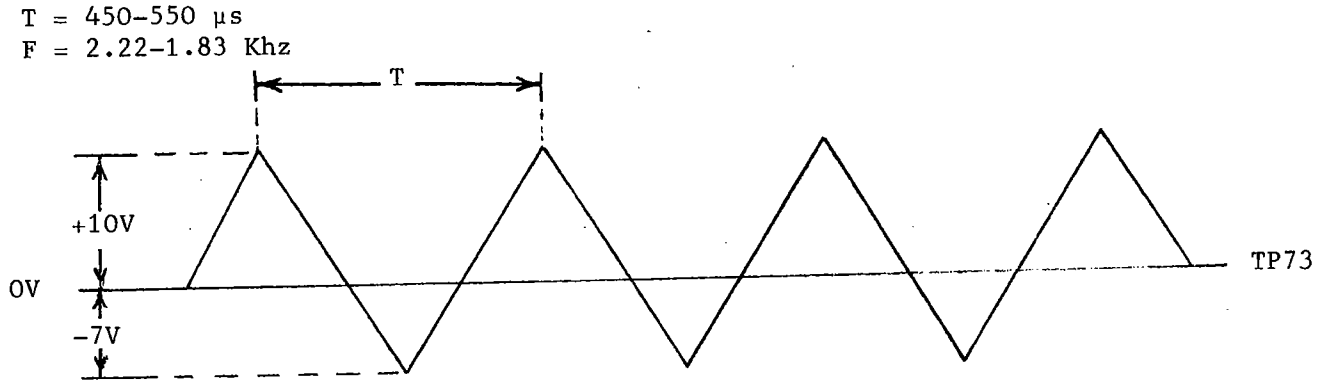
6.10 Triangle Wave Adjustment

Inhibit the BDS2/1. Open the PSR1 circuit breaker. Monitor TP73 with an oscilloscope. Adjust Pot 118 for 9.5 volts peak. Center triangle waveform around zero volts as shown below.

T = 450-550us
F = 2.22-1.82Khz



For amplifiers using BDS2-MC1 or BDS2-MC2 Revision 1 Motor Control Card, adjust triangle waveform as shown below.



6.11 F/V Scaling Adjustment (Not on some units See Fig. 1)

Monitor TP95B with DC digital voltmeter. Run motor to 250 RPM. Adjust Pot 83A for 0.25 volt. Increase motor speed 500 RPM. Adjust Pot 83A for 0.5 volt. Increase motor speed to 1000 RPM. Adjust Pot 83A to 1.0 volt. The voltage level at TP95B is scaled at 1.0 volt/KRPM.

6.12 A and C Phase Current Sample Offset Adjustments

WARNING: DO NOT ADJUST THE CURRENT FEEDBACK GAIN POTS ON THE HALL EFFECT BOARD. THESE ARE FACTORY SET AND SEALED ADJUSTMENTS ONLY. IF A SEAL IS EVER BROKEN, RETURN THE HALL EFFECT BOARD TO THE FACTORY FOR ALIGNMENT OR ORDER A REPLACEMENT BOARD.

Open the "Remote Inhibit" circuit.

Monitor TP36-2 (located on the Comp 3 Card) with respect to common with a DVM. Adjust pot (17) (located on the Dual DHE1 board for zero volts ±0.010V. (If the single H.E.C.S. is used, adjust Pot 2 of the A-Phase (left) board, see Figure 2.)

Monitor TP45-2 (located on the Comp 3 Card) with respect to common with a DVM. Adjust pot (18) (located on the Dual DHE1 board for zero volts ±0.010V. (If the single H.E.C.S. is used, adjust Pot 2 of the C-phase (right) board, see Figure 2.)

6.13 PSR1 Circuit Breaker Adjustment

If nuisance circuit breaker trips are experienced on power up, the circuit breaker trip setting may be adjusted upward; not to exceed the setting of 6.0. Using a screw driver, push in on the adjustment screw and turn. For the best protection, try the lower settings first.

7.0 TROUBLESHOOTING HINTS

In this section, it is assumed that a fault mode about the BDS2 has been confirmed, or that the BDS2 has at least been identified as number one suspect in exhibiting a fault mode.

Some recommended equipment for troubleshooting the BDS2 amplifier is as follows:

1. Adjustable signal source 0-±10VDC (small 9VDC battery with reversing input switches will do)

2. Dual channel oscilloscope

3. Digital Volt-Ohmmeter

Before beginning the troubleshooting process, consider the following points:

I. There are three (3) distinct areas within which a fault may occur:

   1. External Interface
      (a) Circuitry external, but connecting to the BDS2 amplifier. (This area should already have been eliminated as a problem source.)

   2. Control Section
      (a) BDS2-MC2 (Control Board)
      (b) BDS2-BD1 or VFS2-BD1 (Base Drive Board)
      (c) HECS or DHE1 (Hall Effect Current Sensor Board)
      (d) ACS-REG1 or ACS-REG2 Regen Board (PSR1)

   3. Heat Sink (Power Stage)
      (a) Thermostat
      (b) Power Transistor Paks

II. There are only two basic fault characteristics to be considered:

   1. The motor exhibits very low torque or is totally inoperative.

2. There is motor movement; but, exhibits an improper mode of operation.

Please use caution when troubleshooting the BDS2.

The recommended procedure for troubleshooting the unit is with the understanding that the Main Bus and Control Bus power supplies are functioning properly. Check these sections first.

7.1 The Motor Exhibits Very Low Torque or is Totally Inoperative

The prerequisites for motor movement under full torque mode are:

I. Fault circuits must not be activated as displayed by the LED bar graph 274:

1. The correct ±15V and +5V DC control voltage levels must be present at TP13, TP23, and TP31 respectively.

2. The +300/325VDC ±10% main bus level must be present at 4 with respect to 5 of the power terminal block on the BDS2.

3. The "Remote Inhibit" input circuit must be pulled low.

4. The "Direction Limit" input circuits must be pulled low.

5. The "Thermostat" mounted on the heat sink must be closed.

6. There must not be a current "Foldback" or "Overspeed Fault."

7. The "Option Fault" input circuit (if used) must be pulled low.

8. The "Torque Hold" input circuit must be pulled low.

9. The "External Current Limit" input circuit must be pulled low.

10. The Green "Drive-Up" LED (32) must be illuminated.

11. A command signal must be present at the input of the BDS2.

7.2 The Motor is Erratic or Exhibits an Improper Mode of Operation

Although improper operation may be brought about by any one of almost an infinite number of possible fault modes, the following troubleshooting hints will aid in locating some of the most probably faults:

1. High Frequency oscillations exhibited by motor	A.C. Gain Pot (23) located on the Comp Card turned too far CW Turn Pot (23) CCW
2. Motor makes large oscillatory movements or runs away	BDS2 system, backwards in Position Loop (Motor moves in wrong direction) Refer to section 5.0
3. Motor creeps. Will not maintain zero speed	Adjust Zero Pot (114) (Located on large BDS2-MC2 Board) Incorrect grounding scheme. Refer to section 3.1
4. While at zero speed motor jumps out of position or exhibits excessive cogging at low speed.	Check A and C phase Hall Effect Current Sensor offset adjustment per Section 6.12.

7.3 Checking the Individual Modules

Basically the BDS2 is made up of the following modules:

(1) BDS2-MC2 (Control Section) C-M80561-1. Figure 1

(2) BDS2-BD1 or VFS2-BD1 (Base Drive Section) C-M80152-1, C-M80386-1 Figure 2.

(3) HECS (Single) or DHE1 (Dual) (Hall Effect Current Sensing Board(s)) Figure 2 -- C-M79087-1, C-M80585-1

(4) Power Transistor Paks--Figure 3

BDS2/1-208/25	---	A-79957
BDS2/1-208/40	---	A-80641
BDS2/1-208/60,75,90	---	A-80504
BDS2/1-208/130	---	A-80644

The PSR1 power supply is made up basically of only two sections:

(1) The power module and main panel assembly. (Refer to drawing C-79924)

(2) ACS-REG2 (Regen Board) C-80737-1 or the older ACS-REG1 (Regen Board) C-79668-1.

7.3.1 Individual Module Testing

Begin the simplified troubleshooting process by starting with the PSR1 power supply unit.

Under normal operation, the Regen circuit should act, to prevent main bus "pump-up" due to energy feedback during the regeneration cycle, somewhat in the following manner:

(1) The Red LED (on the Regen board) should become illuminated at 375 to 390V DC. This LED will automatically go out at 355 to 365V DC, usually resulting in a blinking action.

(2) The "Regen" LED in bar graph 274 on the BDS2 should become illuminated at 390 to 420V DC and will remain on indicating a fault mode due to excessive regeneration activity. Depress the pushbutton on the Regen Board and this LED will go out. If the main bus is allowed to exceed 420V, severe damage may occur.

Remove power. Check the 30/40 amp fuse. If the fuse is blown, check the power transistor pak with a digital volt-ohmmeter. (Refer to drawing C-79924). Remove the leads from the emitter and base terminals of the power transistor pak (mounted on the large heatsink on the main panel) and check the transistor unit per the following chart:

PSR1 POWER TRANSISTOR TEST CHART

DVM LEAD		DVM LEAD	APPROX.
B-(Red)	to	C-(Black) = LOW	(.5V)
B-(Red)	to	E-(Black) = LOW	(.1V)
B-(Black)	to	C-(Red) = HIGH	(open)
B-(Black)	to	E-(Red) = LOW	(.1V)
C-(Black)	to	E-(Red) = LOW	(.4V)
E-(Black)	to	C-(Red) = HIGH	(open)

Reconnect the two leads (if removed) at the emitter and base terminals of the power transistor. Install a jumper between TP7 and TP31 of the ACS-REG2 board C-80737-1 or TP20 and 34 of the older ACS-REG1 board C-79668-1 to disable the output transistor pak. (Mounted on the large heatsink on the main panel)

Open the "Remote Inhibit" and the "Torque Hold" input circuits. Apply power.

With a DC voltmeter, monitor 3 with respect to 4 on the power terminal block of the PSR1. The main bus voltage should be +300/325 VDC ±15%. Observe the bus current with a DC current probe around the positive output lead at 4, the current should not exceed 40 ma. Monitor TP28 on the ACS-REG2 or TP33 on the older ACS-REG1. The voltage should be 13.0 - 16.5V DC.

Monitor TP27 on the ACS-REG2. It should be +8.25 volts. Also monitor TP4. It should be +6.1 volts. If ACS-REG1 board is used, monitor TP30 and TP38. The voltage levels should be the same as ACS-REG2 board. (Refer to section 6.2)

With an oscilloscope, monitor 3 with respect to 4 on the Regen board terminal block. (Refer to C-79924-1) Depress the test button on the Regen board and a pulse of approximately 1.5 volts and 20 msec. in with should occur.

Remove power. Remove the jumper from the Regen board.

Check the BDS2-BD1 or VFS2-BD1 board in the following manner. First check the ribbon cable. Note the "arrows" marked on both halves of the connectors. The "arrows" should be aligned and the plugs securely in place.

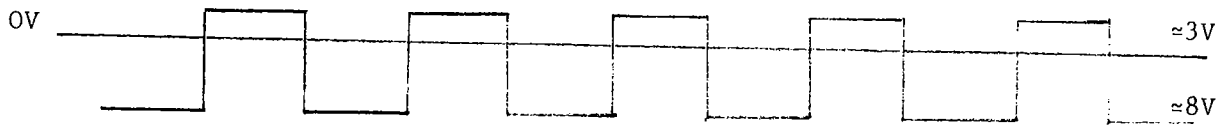
Open the circuit breaker on the PSR1 unit. Apply only the 115V AC power to the BDS2 amplifier.

DO NOT APPLY THE MAIN BUS VOLTAGE

With a DC voltmeter, monitor the positive side of C14 with respect to the GND TP on "A Bottom" base drive circuit of the BDS-BD1 board. (Refer to drawing C-M80152-1 and Figure 2). The voltage should be +8.0V ±.5V. Monitor the negative side of C13. The voltage should be -8.0V ±.5V. If a VFS2-BD1 board is used, monitor the positive side of C13 and negative side of C14 in the A-TOP circuit. (Refer to drawing C-80386-1) Repeat for each of the other five base drive circuits.

Close the "Remote Inhibit" input circuit leaving the "Torque Hold" input circuit open. Using a manual input command source (battery box, etc.) apply 1.0 volt to the input of the BDS2.

With an oscilloscope, monitor fuse clip (10) on "A-Bottom" ("A-TOP" if VFS2-BD1) base drive. Connect the scope common to the GND TP of "A-Bottom" ("A-TOP" if VFS2-BD1) circuit. The waveform should appear as follows:



Have a colleague rotate the motor shaft slowly by hand. The waveform should vary in duty cycle. Repeat for each of the other five base drive circuits. Move scope gnd. accordingly.

If any of the BDS2-BD1 (or VFS2-BD1) fuses are blown or if any of the base drive circuits prove to be defective, remove the power and check the power transistor pak associated with the base drive section. Check to be sure that the large capacitors have discharged.

Remove the connections from the affected power transistor pak. With a DVM in the diode test mode, check the power transistor pak by placing the RED and BLACK probes of the meter on the designated points according to the following chart:

POWER TRANSISTOR TEST CHART

BDS2/1-208/25,40,60,75,90

DVM LEAD		DVM LEAD	
B1 (Red)	to	C1 (Black)	= LOW
B1 (Red)	to	E1 (Black)	= LOW
B1 (Black)	to	C1 (Red)	= HIGH
B1 (Black)	to	E1 (Red)	= LOW
C1 (Black)	to	E1 (Red)	= LOW
C1 (Red)	to	E1 (Black)	= HIGH
B2 (Red)	to	C2-E1 (Black)	= LOW
B2 (Red)	to	E2 (Black)	= LOW
B2 (Black)	to	C2-E1 (Red)	= HIGH
B2 (Black)	to	E2 (Red)	= LOW
C2-E1 (Black)	to	E2 (Red)	= LOW
C2-E1 (Red)	to	E2 (Black)	= HIGH

BDS2/1-208/130

B (Red)	to	C (Black)	= LOW
B (Red)	to	E (Black)	= LOW
B (Black)	to	C (Red)	= HIGH
B (Black)	to	E (Red)	= LOW
C (Black)	to	E (Red)	= LOW
C (Red)	to	E (Black)	= HIGH

Check the large BDS2-MC2 board in the following manner. (Refer to drawing C-M80561-1 and Figure 1)

Open the circuit breaker on the PSR1 unit. Close the "Remote Inhibit" input circuit and open the "Torque Hold" input circuit. Only the 115V AC power should be applied. Connect a jumper between 8 and 9 of the power terminal block on the BDS2 amplifier to defeat the Regen fault circuit (due to the absence of the main bus voltage).

Remove and reapply the 115V AC power to reset any fault circuits. If there are any fault(s) which can not be cleared or if a fault persists in reoccuring check to be sure that all of the prerequisites for the "Drive-Up" mode are met per section 7.1.

If the prerequisites for the "Drive-Up" mode are present, and no legitimate fault mode can be confirmed while one or more section(s) of diagnostic bar graph 274 is illuminated; then in all probability the defect lays with the input connectors or fault circuits located on the BDS2-MC2 board.

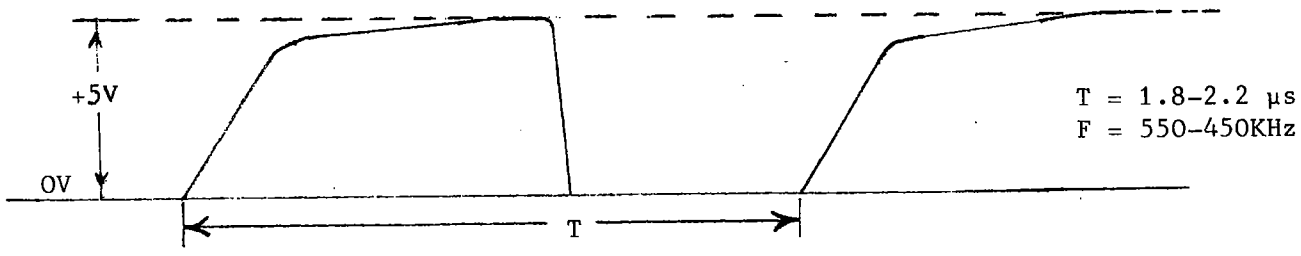
The control bus at TP13 and TP23 should be $\pm$15V DC $\pm$0.05V with respect to common TP13A.

The control bus at TP31 should be +5V DC $\pm$0.2V with respect to common TP13A.

Reference all DVM and scope reading to TP13A on the BDS2-MC2 board, unless stated otherwise.

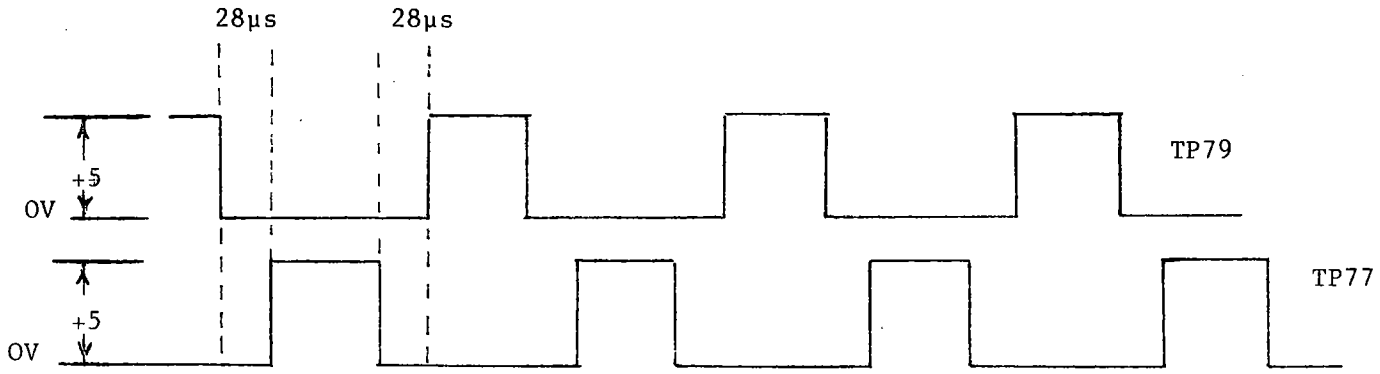
With oscilloscope, monitor TP52 located in the resolver excitation circuit. The waveform should appear as shown in section 6.9.

With scope, monitor TP157 located in the system clock circuit. The waveform should appear as follows:



With scope, monitor TP73 at the Modulation Hybrid. The waveform should appear as shown in section 6.10.

With an oscilloscope, monitor TP79 with channel 1. Monitor TP77 with channel 2. Have a colleague rotate the motor shaft with a constant smooth movement for one complete revolution. The following waveforms should be present:



To check the Hall Effect Current sensors, do the following:

Open the "Remote Inhibit" input circuit. With a DVM monitor TP36-2 on the Comp 3 board with respect to common. The voltage level should be zero volts ±0.010V. Monitor TP45-2 on the Comp 3 board. The voltage should be zero volts ±0.010V. If necessary, readjust the zero offset pots per section 6.12.

Open the "Torque Hold" input circuit. close the "Remote Inhibit" circuit. Run the motor at a low speed 100 to 500 R.P.M.

With an oscilloscope, monitor TP36-2 and TP45-2 on the Comp 3 card. A sinewave whose frequency varies with speed should be present.

8.0 SPEED AND CURRENT MONITORING INFORMATION

The Tach Voltage may be observed at TP113 on the BDS2-MC2 board. The waveform appearing at TP113 is a multiplexed composite of the resolver and brushless tach feedback signals. Therefore, there is a direct relationship between this waveform and the actual motor speed.

A D.C. voltmeter wired into the mating connector 233 at Pin 14 with respect to Pin 16 or 17, calibrated in R.P.M. or IN/MIN etc. can serve as a means by which motor speeds may be monitored. Refer to the TL sheet for the system, for the scale factor in volts/R.P.M.

The Current Monitor waveform may be observed at TP55 on the BDS2-MC2 board. The waveform appearing at TP55 is a combination of the three phase stator currents and represents a RMS composite current.

A D.C. voltmeter wired into the mating connector 233 at Pin 15 with respect to Pin 16 or 17, calibrated in either current or lb.-ft., can serve as a means by which constant load levels placed on the motor may be monitored. Refer to the TL sheet for the system, for the scale factor in Amps/Volt. (average)

9.0 SPARE PARTS LIST

BDS2 RECOMMENDED SPARE PARTS LIST

BDS2/1-208

MODEL NUMBER	DESCRIPTION
BDS2-MC2	Motor Control Board
A-80286	Diff. Input and Current Limit Hybrid
A-80287	Interface Hybrid
A-80288	Modulation Hybrid
BDS2-Comp3	Compensation Board
A-80294	8 Bit Eprom
A-80293	R/D Converter
DHE1	Dual Hall Effect Board
A-79776-09	Prom 4-Pole Brushless Tach - 238
A-79711-001	Prom 256x4 Open Collector
A-79776-12	Prom BDS2 6-Pole 4.5
A-78899-013	Fuse 5 amp 125V
BDS2-102	Connector Kit with crimp terminal
A-80550-002	Cable Clamp Assembly, 15 Position
A-80550-003	Cable Clamp Assembly, 25 Position
A-80629-002	Receptacle Shell, 15 Position
A-80629-003	Receptacle Shell, 25 Position
A-80630	Contact, Crimp SNAP-IN 22-18 AWG

BDS2/1-208/25

BDS2-BD1-01	Base Driver Board
A-78900-004	Fuse 1/2 Amp 250V
A-80078	Thermostat
A-79957	Power Transistor Module (75A)

BDS2/1-208/40

MODEL NUMBER	DESCRIPTION
BDS2-BD1-02	Base Driver Board
A-78900-004	Fuse 1/2 Amp 250V
A-80078	Thermostat
A-80641	Power Transistor Module (100A)
A-78782-001	Fan 4" 115V

BDS2/1-208/60

BDS2-BD1-03	Base Driver Board
A-78900-004	Fuse 1/2 Amp 250V
A-29616	Thermostat
A-80504	Power Transistor Module (150A)
A-79054-001	Fan 6" 115V

BDS2/1-208/75

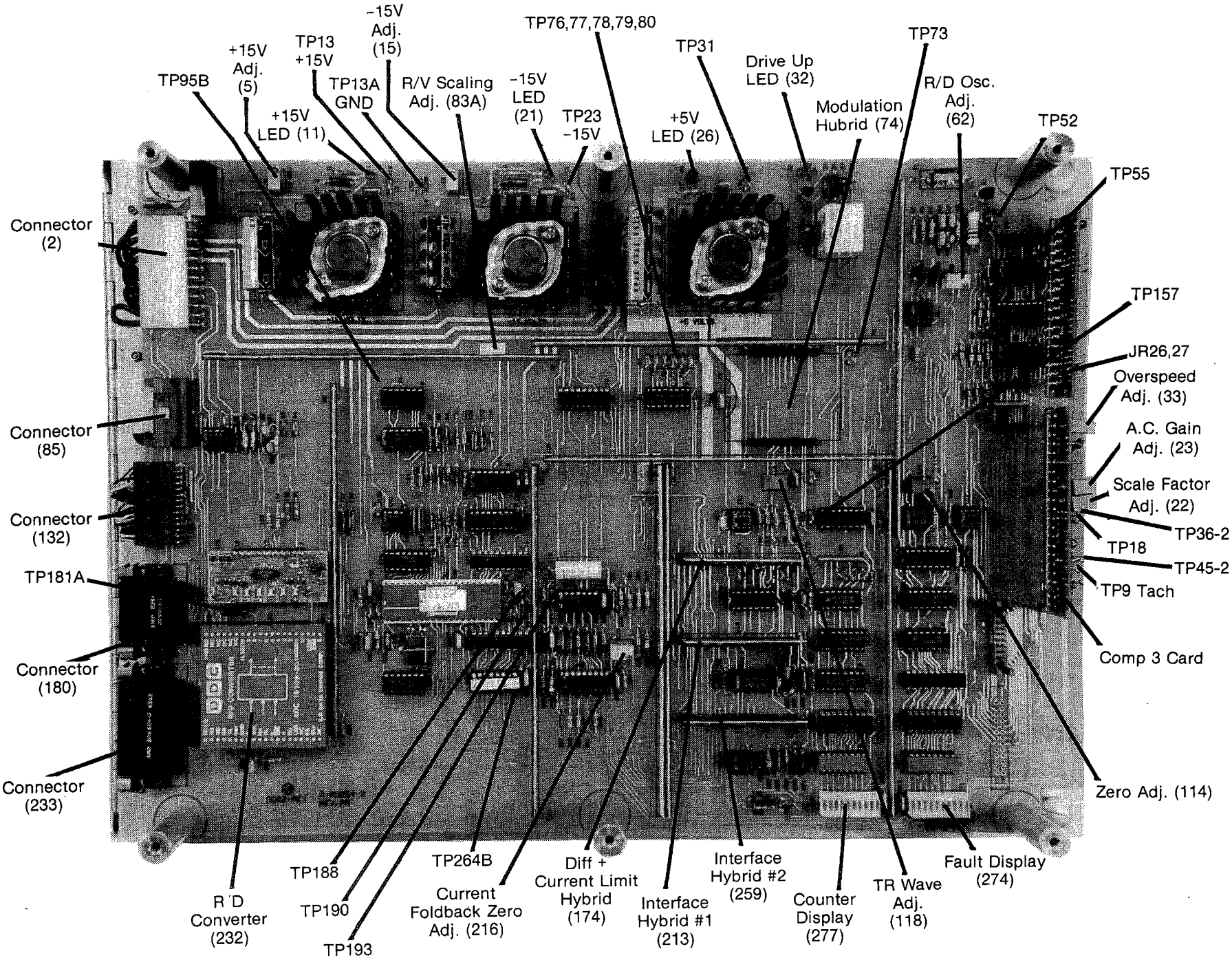
VFS2-BD1	Base Driver Board
A-78899-008	Fuse 1 1/2 Amp 250V
A-78900-005	Fuse 3/4 Amp 250V
A-80078	Thermostat
A-80504	Power Transistor Module (150A)

BDS2/1-208/90

VFS2-BD1	Base Driver Board
A-78899-008	1 1/2 Amp 250V
A-78900-005	3/4 Amp 250V
A-80078	Thermostat
A-80504	Power Transistor Module (150A)

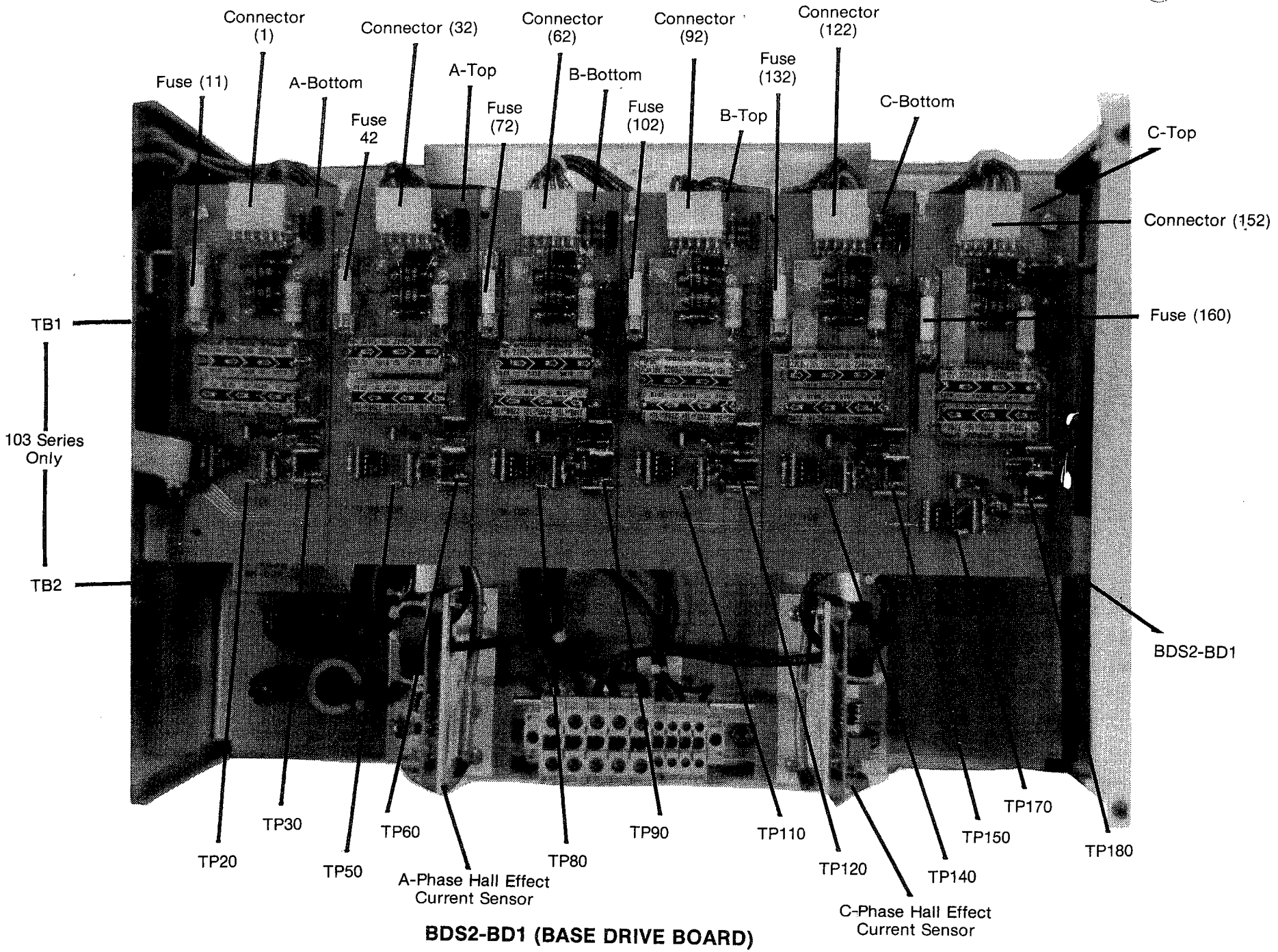
BDS2/1-208/130

MODEL NUMBER	DESCRIPTION
VFS2-BD1	Base Driver Board
A-78899-008	1 1/2 Amp 250V
A-78900-005	3/4 Amp 250V
A-29616	Thermostat
A-80644	Power Transistor Module (300A)
A-78782-001	Fan 4" 115V

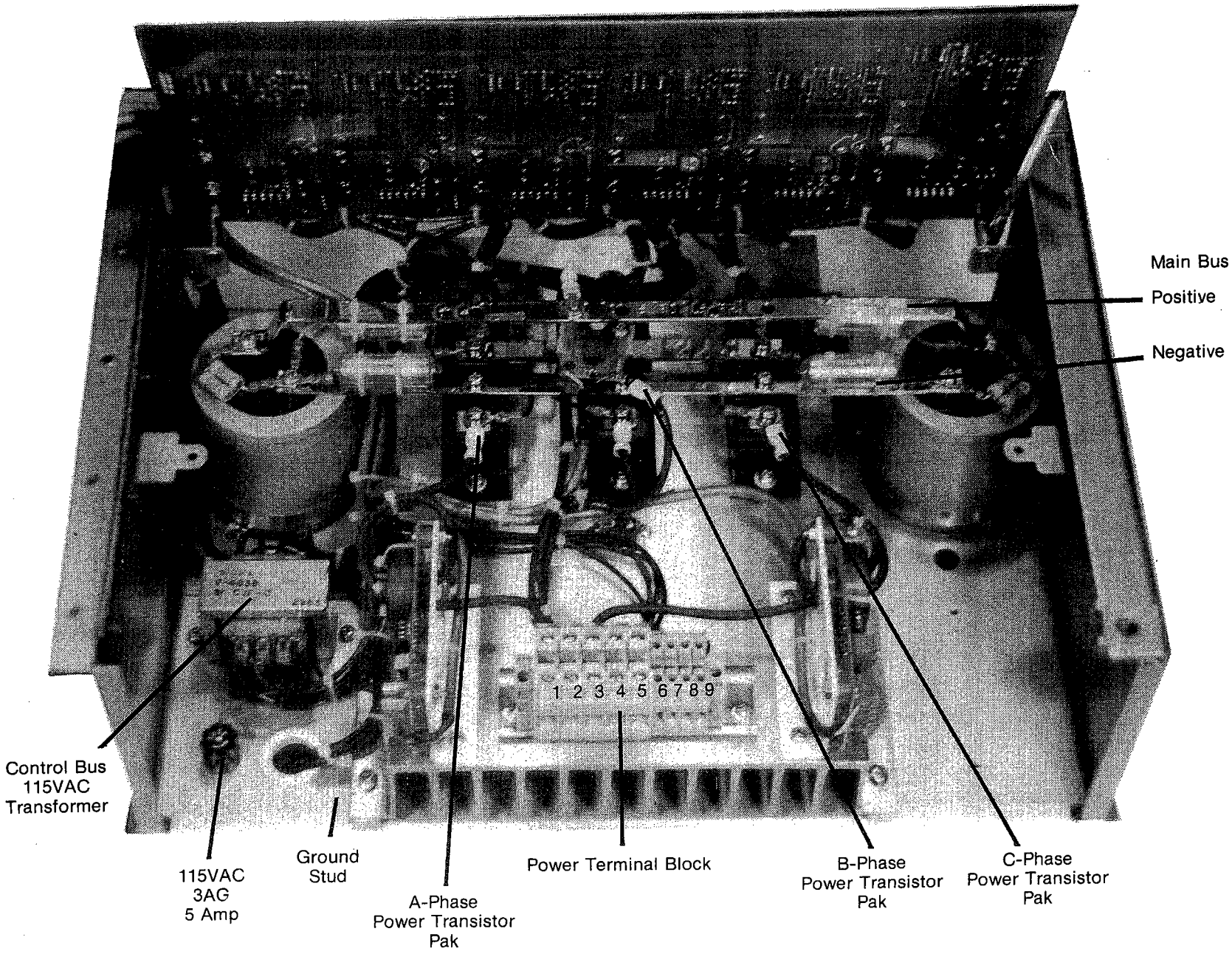


BDS2/1 SERIES BDS2-MC2 CONTROL STAGE

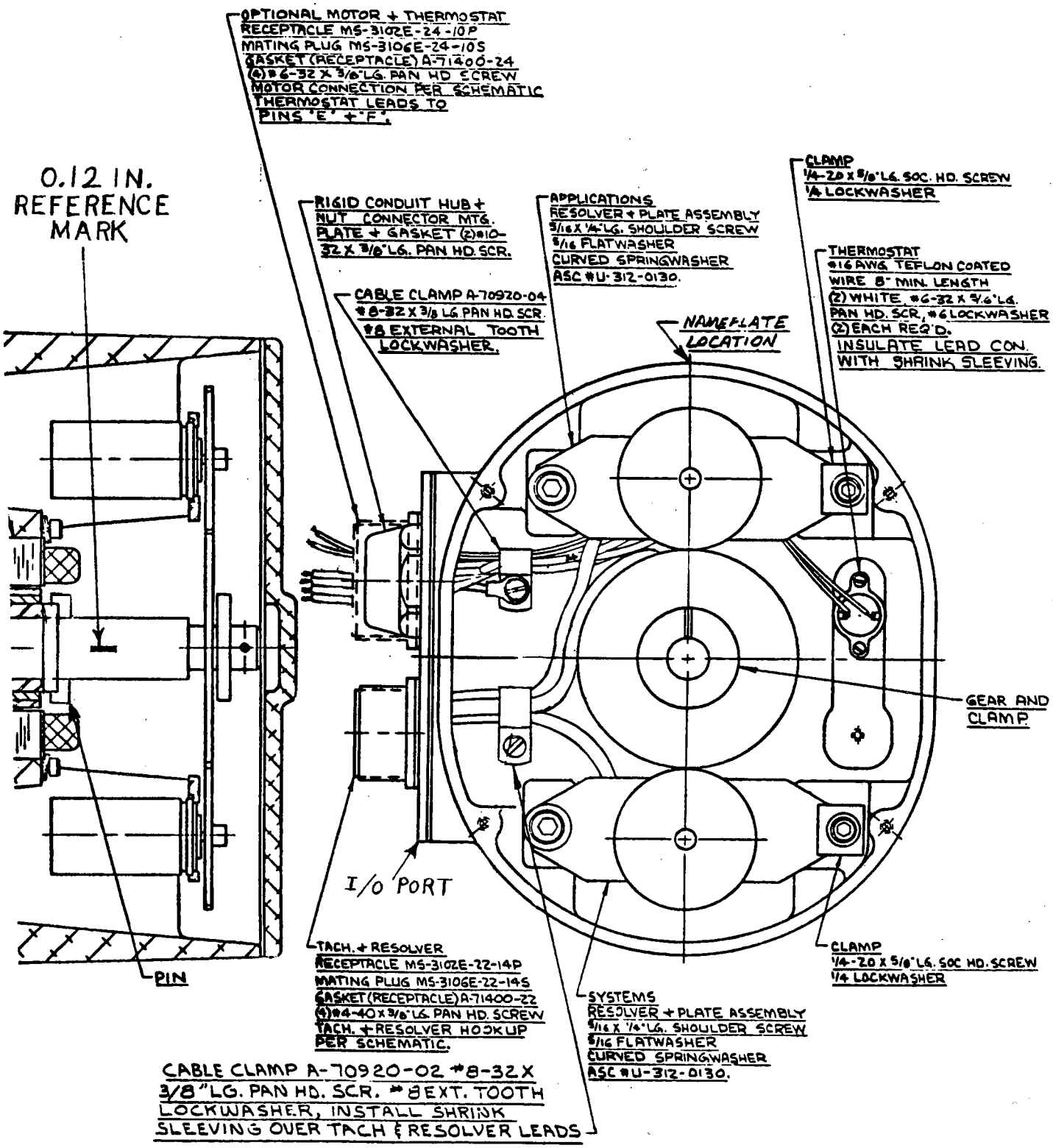
FIGURE 1



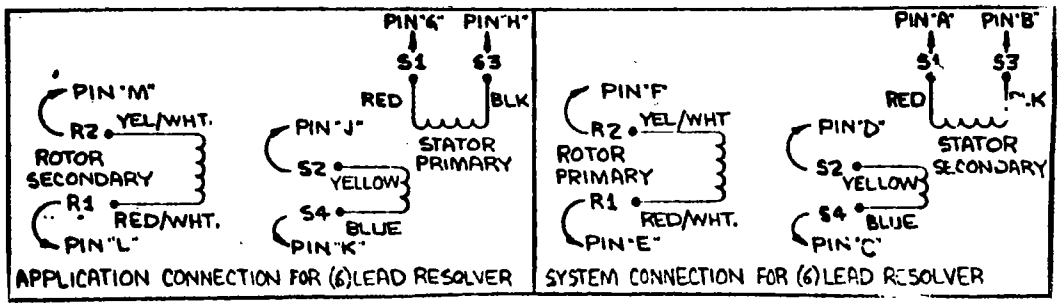
BDS2-BD1 (BASE DRIVE BOARD)
FIGURE 2



BDS2/1 SERIES POWER STAGE
FIGURE 3



Motor Rear End Bell
Figure 4

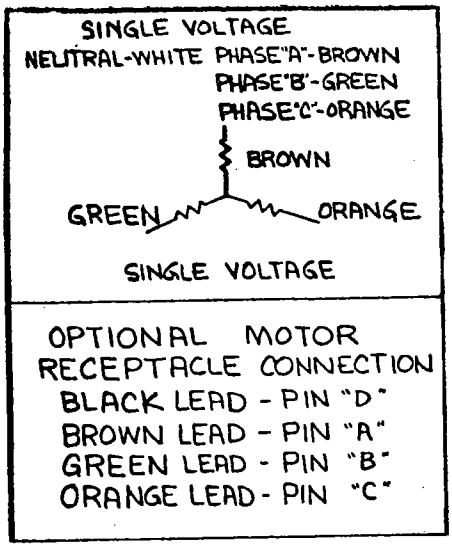


N/C RESOLVER CONNECTIONS

BDS2/1 RESOLVER CONNECTIONS

TACH. CONNECTION DIAGRAM	
"N"	NEUTRAL WHITE
"P"	PHASE "A" BLACK
"R"	PHASE "C" COMPLEMENTARY (C) BLUE
"S"	PHASE "B" COMPLEMENTARY (B) BROWN
"T"	PHASE "A" COMPLEMENTARY (A) GREEN
"U"	PHASE "C" ORANGE
"V"	PHASE "B" RED

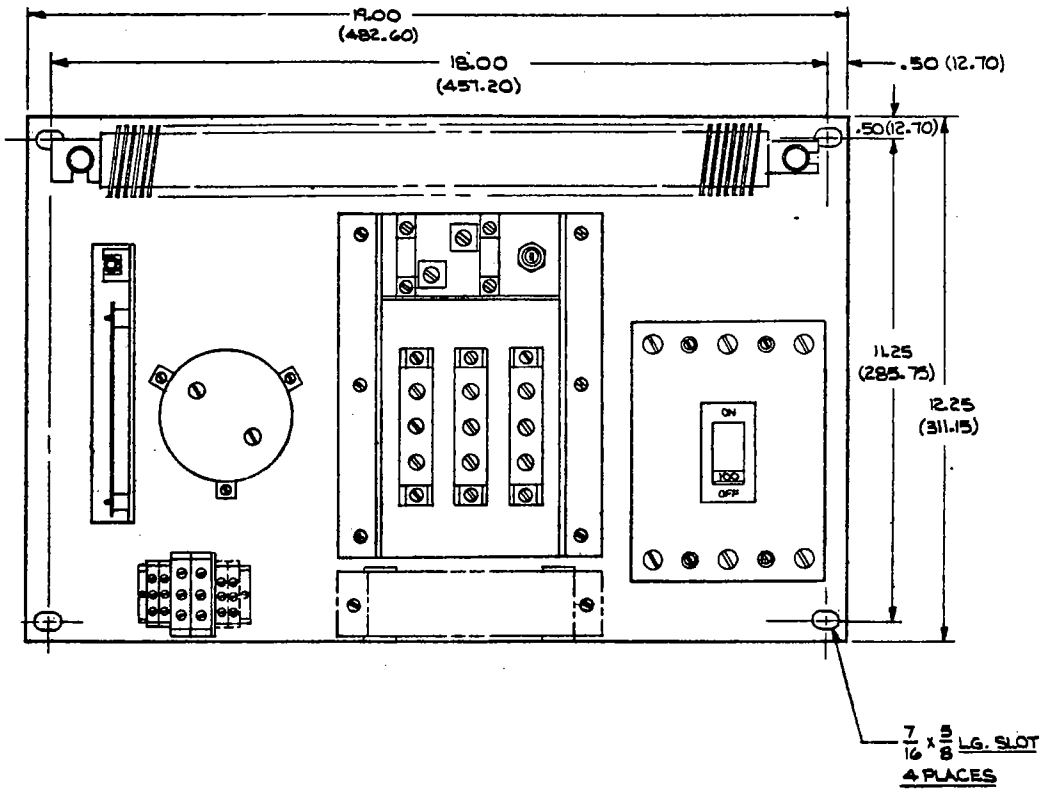
BRUSHLESS TACH CONNECTIONS

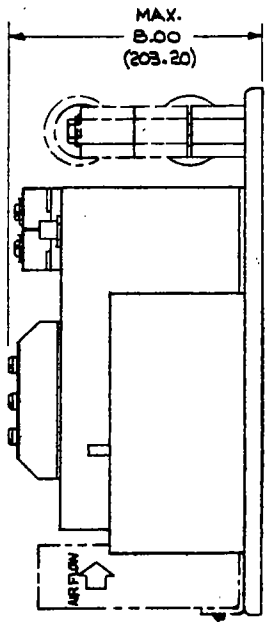


BRUSHLESS MOTOR CONNECTIONS

Figure 5

DO NOT SCALE DWG. USE DIMENSIONS ONLY ALL DIMENSIONS ARE INCHES UNLESS OTHERWISE SPECIFIED	UNLESS OTHERWISE SPECIFIED XX DEC. PLACES ± .01 XXX DEC. PLACES ± .005 ANG. DIM. ± 1°	UNLESS OTHERWISE SPECIFIED REMOVE ALL BURRS AND BREAK ALL SHARP EDGES	DWG SIZE C	DWG. NO. 79671	REV. 1





NOTES:
1)-DIMENSIONS IN PARENTHESIS ARE EXPRESSED IN MILLIMETERS.

MATERIAL	HEAT TREAT	FINISH	DWN BY FDO 11/9/82
NO. / ECN NO. / DATE / APP'D	NO / ECN NO / DATE / APP'D	NO / ECN NO / DATE / APP'D	CHK'D BY
			APP'D BY E.T.R. 11/29/82
			APP'D BY
			APP'D BY

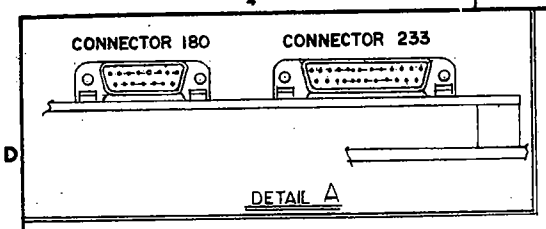
INDUSTRIAL DRIVES DIVISION
RADFORD, VIRGINIA

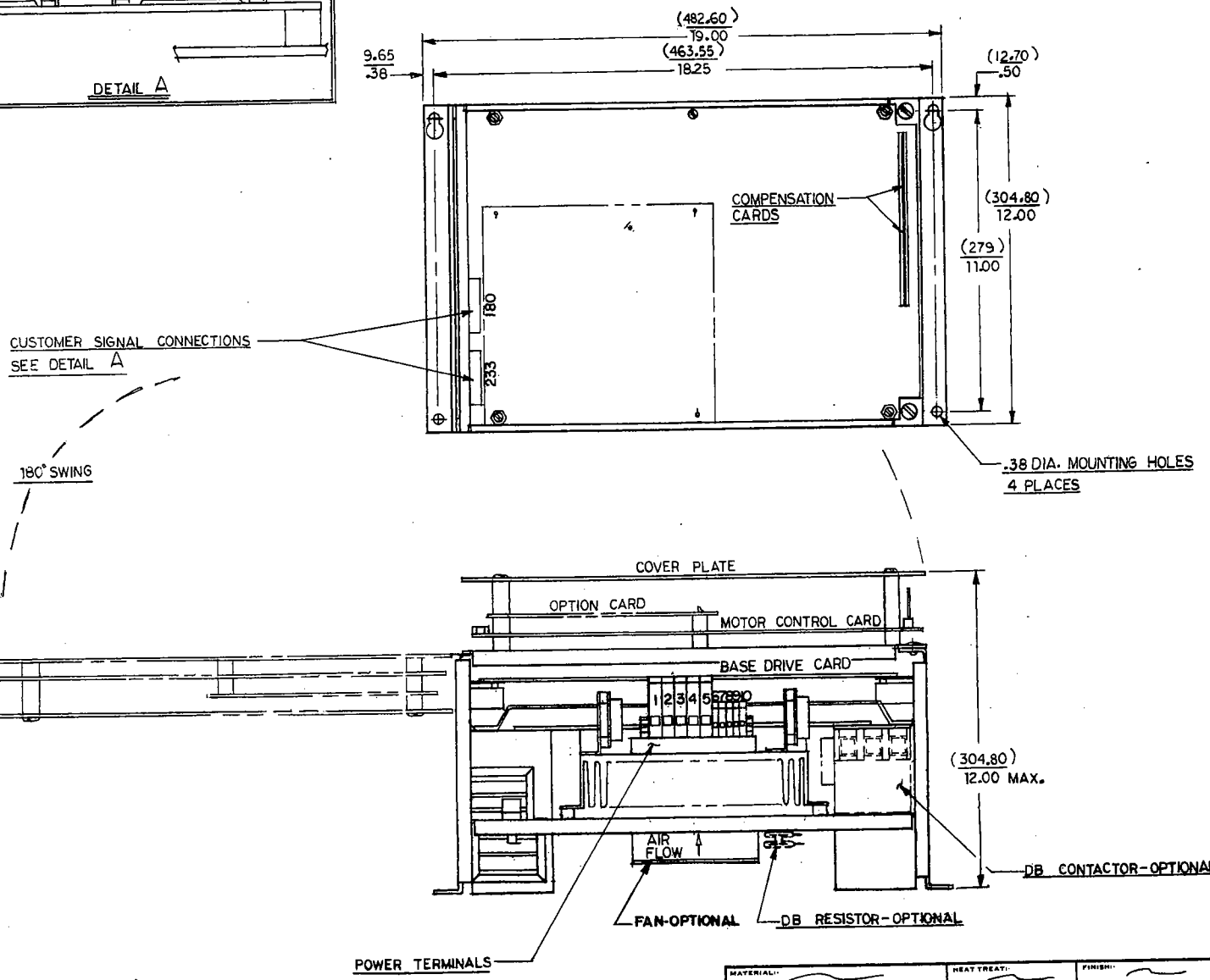
OUTLINE & DIMENSION
PS21-208/040 & /100

SCALE: | PART LIST NO.

DWG SIZE C | DWG NO. 79671 | REV. 1

DO NOT SCALE DWG. USE DIMENSIONS ONLY. ALL DIMENSIONS ARE INCHES UNLESS OTHERWISE SPECIFIED. | UNLESS OTHERWISE SPECIFIED XX DEC. PLACES ± .01 XXX DEC. PLACES ± .005 ANG. DIM. ± 1° | UNLESS OTHERWISE SPECIFIED REMOVE ALL BURRS AND BREAK ALL SHARP EDGES | SIZE C | DWG. NO. 80252





NOTES:

1) DIMENSION = (MM) / INCHES

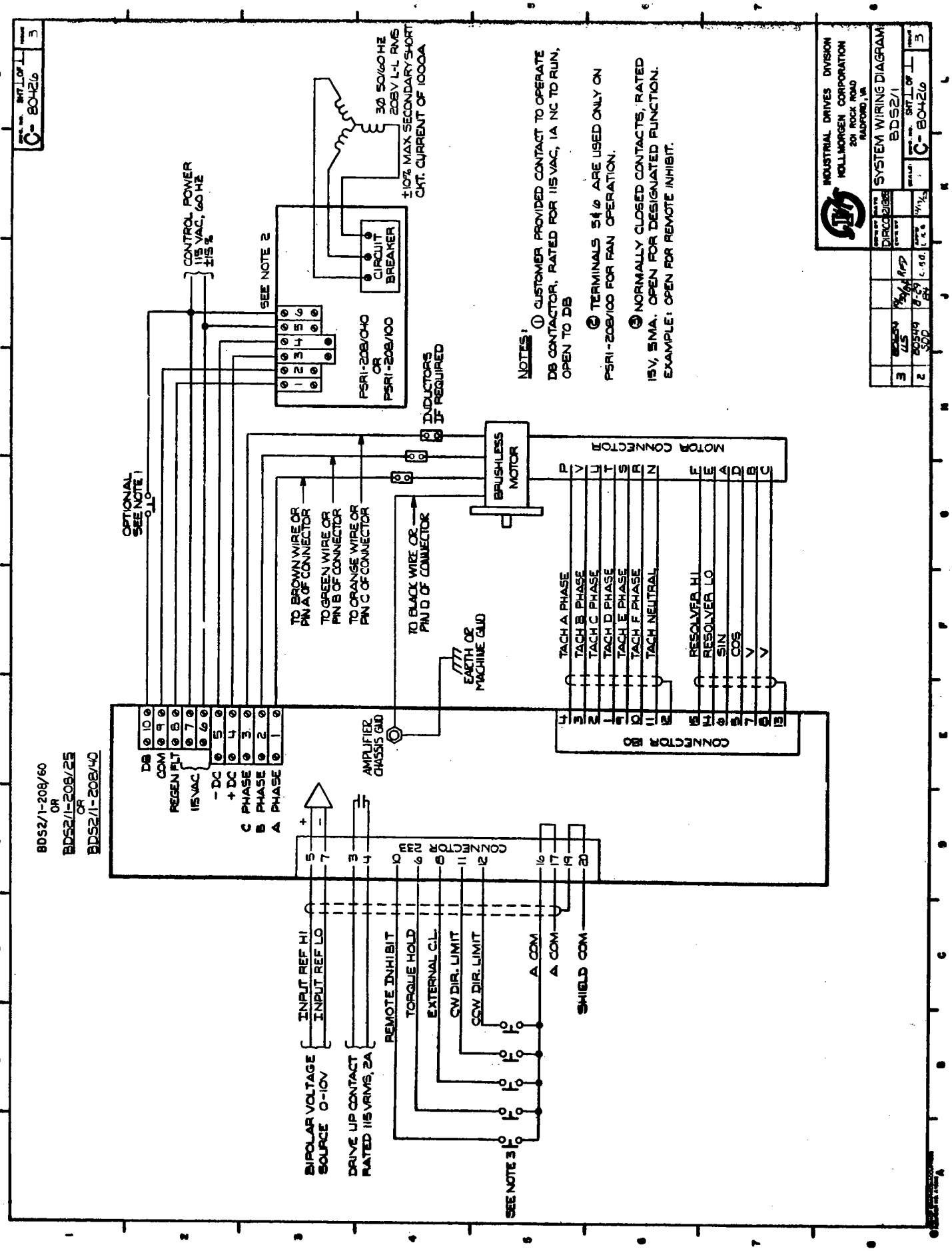
MATERIAL:				HEAT TREAT:				FINISH:			
NO.	ECN NO.	DATE	APP'D.	NO.	ECN NO.	DATE	APP'D.				
				2	80589	5-29-84	L.44	DW'N BY	OWENS	DATE	11/85
				3	81284	7/11/85	OWENS	CH'K BY			
								APP'D BY			
								APP'D BY			
								APP'D BY	L.44.	DATE	12/13/85

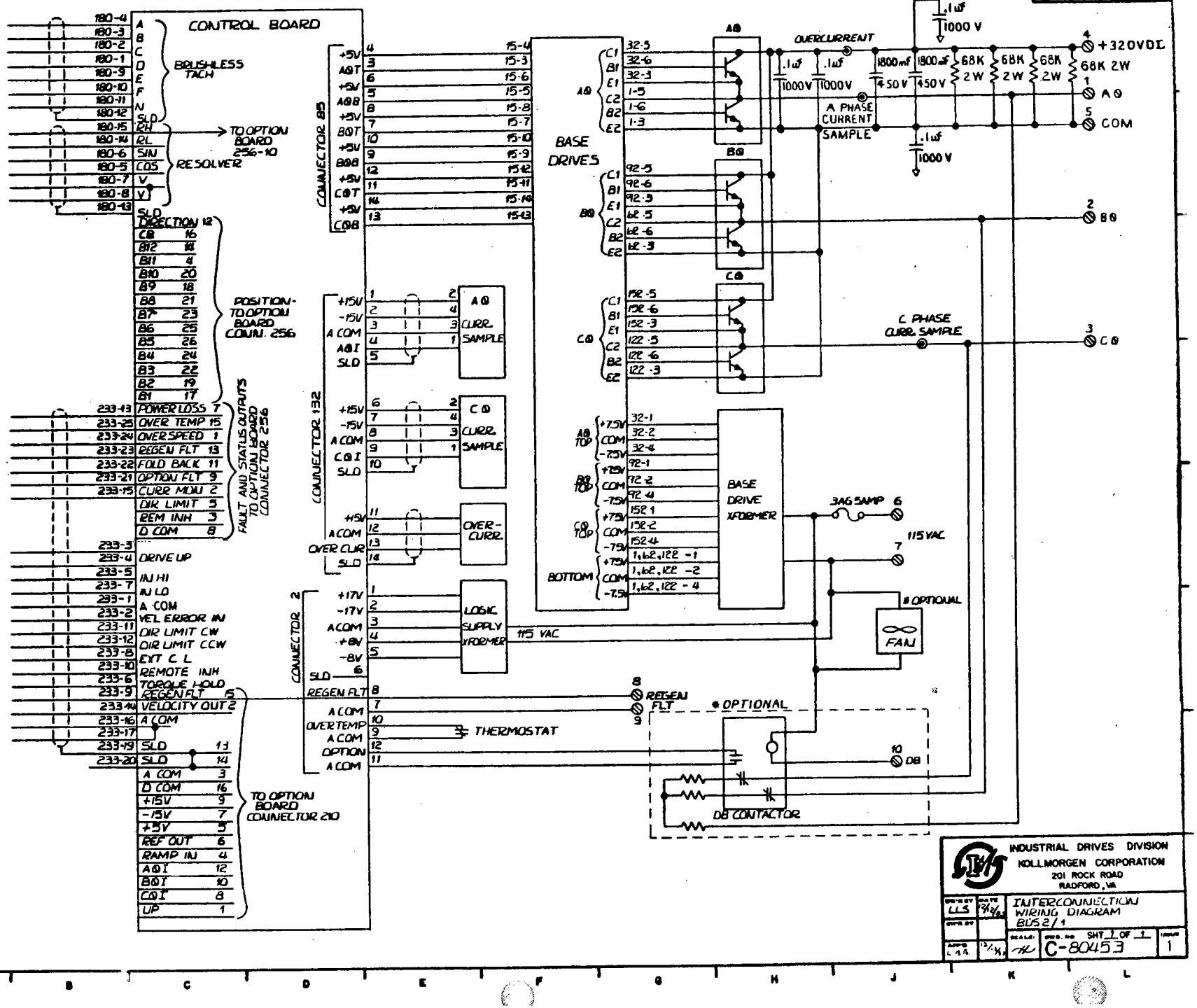
KOLLMORGEN CORPORATION — INDUSTRIAL DRIVES DIVISION — RADFORD, VIRGINIA

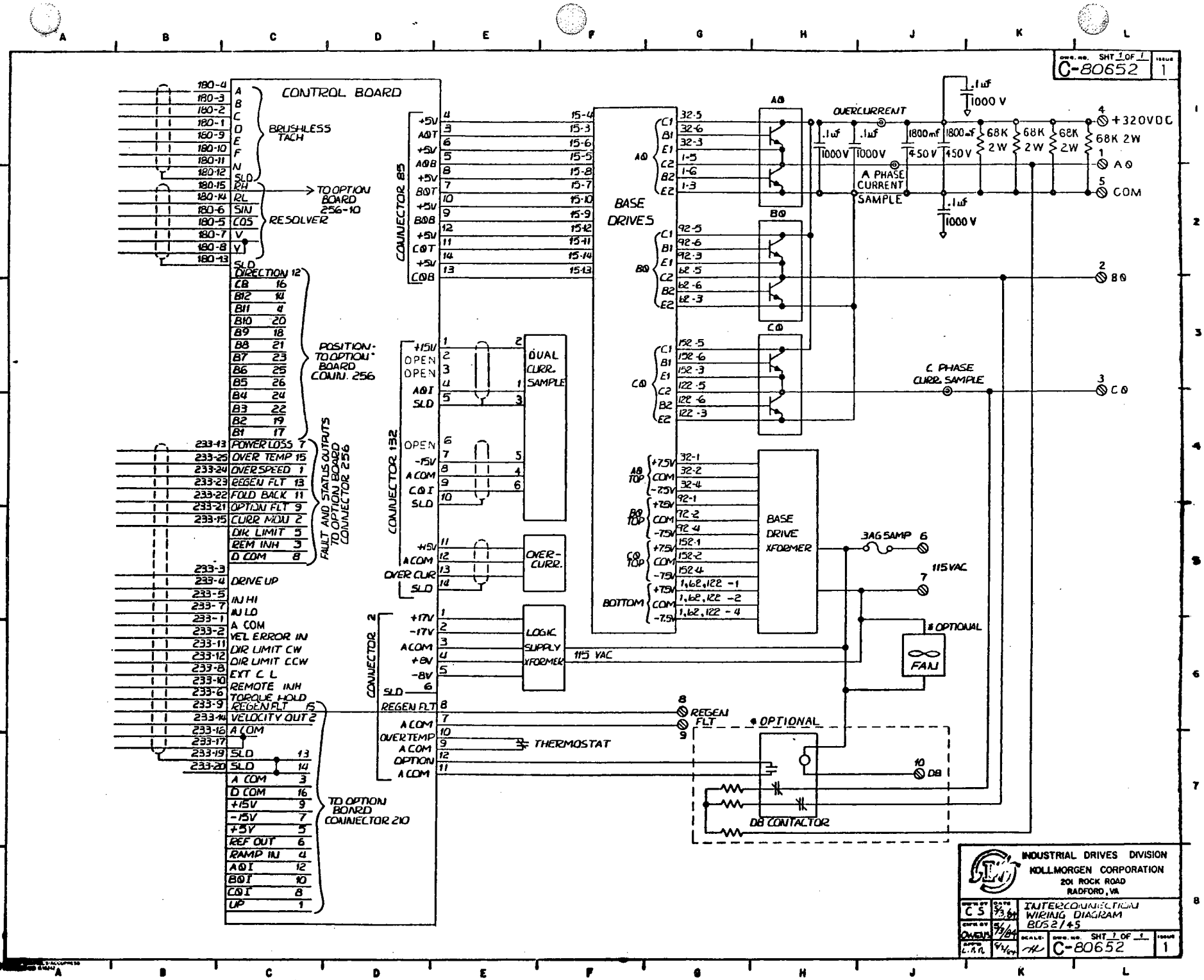
BDS2/1-208/25, 208/40
OUTLINE AND DIMENSION

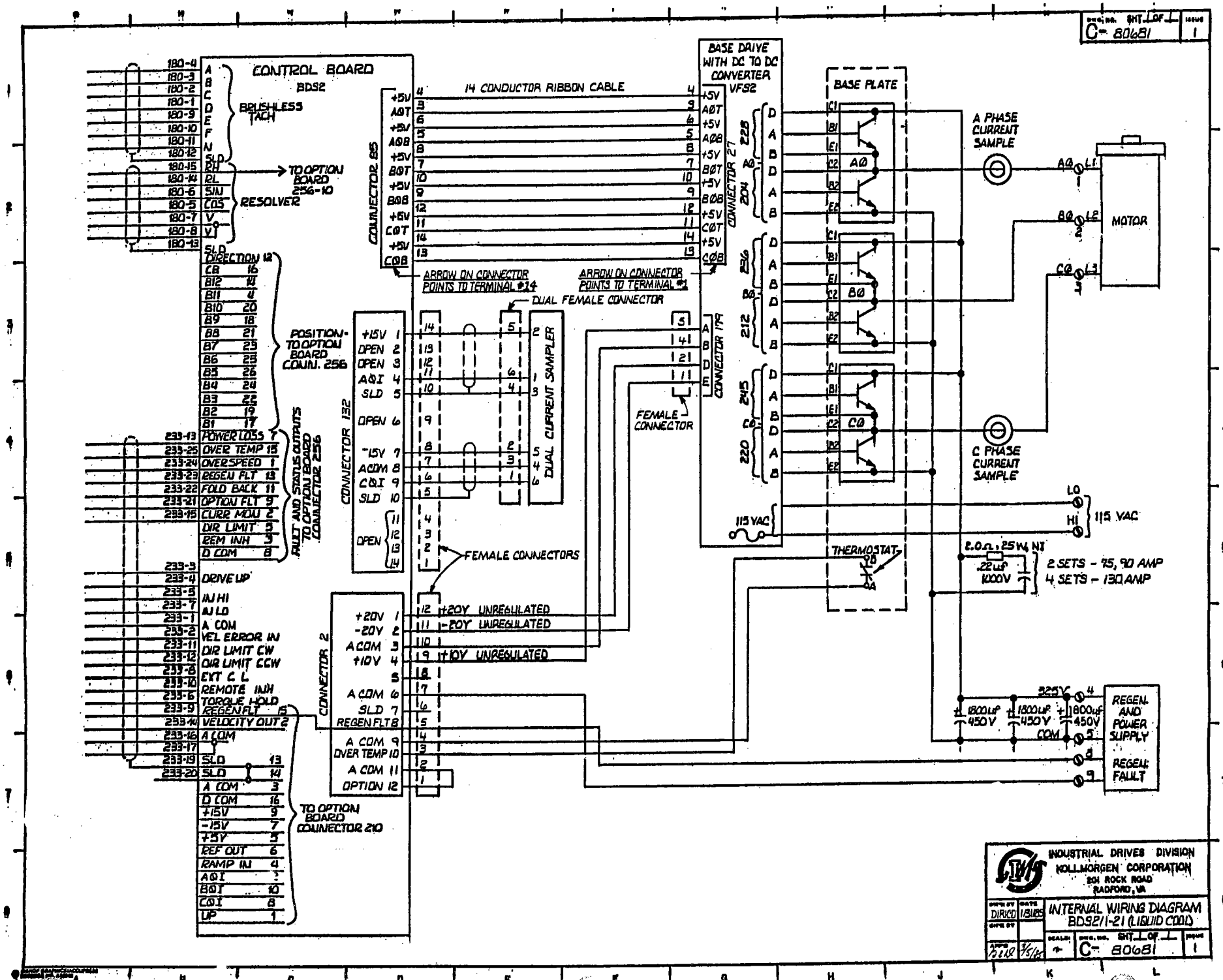
SCALE: | PART LIST NO.

DWG SIZE C | DWG. NO. 80252 | REV. 2


SYSTEM WIRING DIAGRAM
BDS2/1
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA
C-80426
NOTES:
① CUSTOMER PROVIDED CONTACT TO OPERATE DB CONTACTOR, RATED FOR 115 VAC, 1A NC TO RUN, OPEN TO DB
② TERMINALS 5 & 6 ARE USED ONLY ON PSRI-208/100 FOR FAN OPERATION.
③ NORMALLY CLOSED CONTACTS, RATED 15V, 5MA. OPEN FOR DESIGNATED FUNCTION. EXAMPLE: OPEN FOR REMOTE INHIBIT.
CONTROL POWER 115 VAC, 60 HZ ±15 %
SEE NOTE 2
CIRCUIT BREAKER
PSRI-208/040 OR PSRI-208/100
INDUCTORS IF REQUIRED
OPTIONAL SEE NOTE 1
BRUSHLESS MOTOR
MOTOR CONNECTOR
TACH A PHASE
TACH B PHASE
TACH C PHASE
TACH D PHASE
TACH E PHASE
TACH F PHASE
TACH NEUTRAL
RESOLVER HI
RESOLVER LO
SIN
COS
CONNECTOR 180
CONNECTOR 133
DB
COM
REGEN FLT
115 VAC
- DC
+ DC
C PHASE
B PHASE
A PHASE
AMPLIFIER CHASSIS GND
EARTH OR MACHINE GND
INPUT REF HI
INPUT REF LO
BIPOLAR VOLTAGE SOURCE 0-10V
DRIVE I/P CONTACT RATED 115 VRMS, 2A
REMOTE INHIBIT
TORQUE HOLD
EXTERNAL C.L.
CW DIR. LIMIT
CCW DIR. LIMIT
A COM
A COM
SHIELD COM
SEE NOTE 3
BDS2/1-208/60 OR BDS2/1-208/25 OR BDS2/1-208/40


CONTROL BOARD
BRUSHLESS TACH
RESOLVER
TO OPTION BOARD 256-10
POSITION-TO OPTION BOARD CONN. 256
FAULT AND STATUS OUTPUTS TO OPTION BOARD CONNECTOR 256
TO OPTION BOARD CONNECTOR 210
CONNECTOR 85
CONNECTOR 132
CONNECTOR 2
BASE DRIVES
BASE DRIVE XFORMER
OVERCURRENT
A PHASE CURRENT SAMPLE
C PHASE CURR. SAMPLE
+320VDC
A Ø
B Ø
C Ø
COM
115 VAC
LOGIC SUPPLY XFORMER
FAN
* OPTIONAL
DB CONTACTOR
DB
REGEN FLT
THERMOSTAT
OVER-CURR.
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA
INTERCONNECTION WIRING DIAGRAM
BUS 2 / 1
C-80453

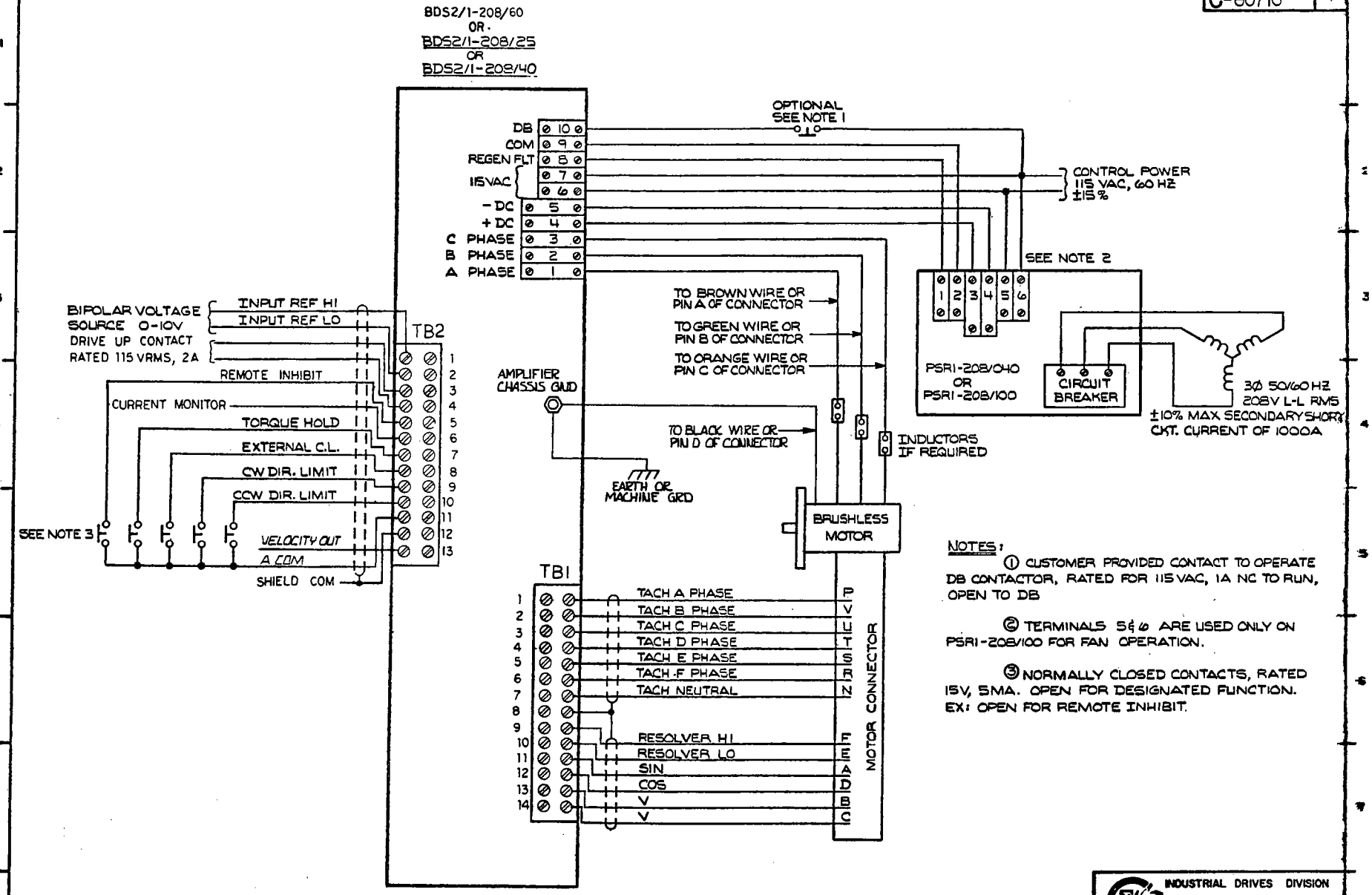

CONTROL BOARD
BRUSHLESS TACH
RESOLVER
TO OPTION BOARD 256-10
POSITION TO OPTION BOARD CONN. 256
FAULT AND STATUS OUTPUTS TO OPTION BOARD CONNECTOR 256
TO OPTION BOARD CONNECTOR 210
CONNECTOR 85
CONNECTOR 132
CONNECTOR 2
DUAL CURR. SAMPLE
OVER-CURR.
LOGIC SUPPLY XFORMER
BASE DRIVES
BASE DRIVE XFORMER
OVERCURRENT
A PHASE CURRENT SAMPLE
C PHASE CURR. SAMPLE
+320VDC
A0
B0
C0
COM
115 VAC
3AG SAMP
FAN
* OPTIONAL
DB CONTACTOR
THERMOSTAT
REGEN FLT
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA
INTERCONNECTION WIRING DIAGRAM
BDS 2/45
C-80652



INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA

INTERNAL WIRING DIAGRAM
BDS2/1-21 (LIQUID COOL)

C- 80681 | ISSUE 1



NOTES:

① CUSTOMER PROVIDED CONTACT TO OPERATE DB CONTACTOR, RATED FOR 115 VAC, 1A NC TO RUN, OPEN TO DB

② TERMINALS 5 & 6 ARE USED ONLY ON PSR1-208/100 FOR FAN OPERATION.

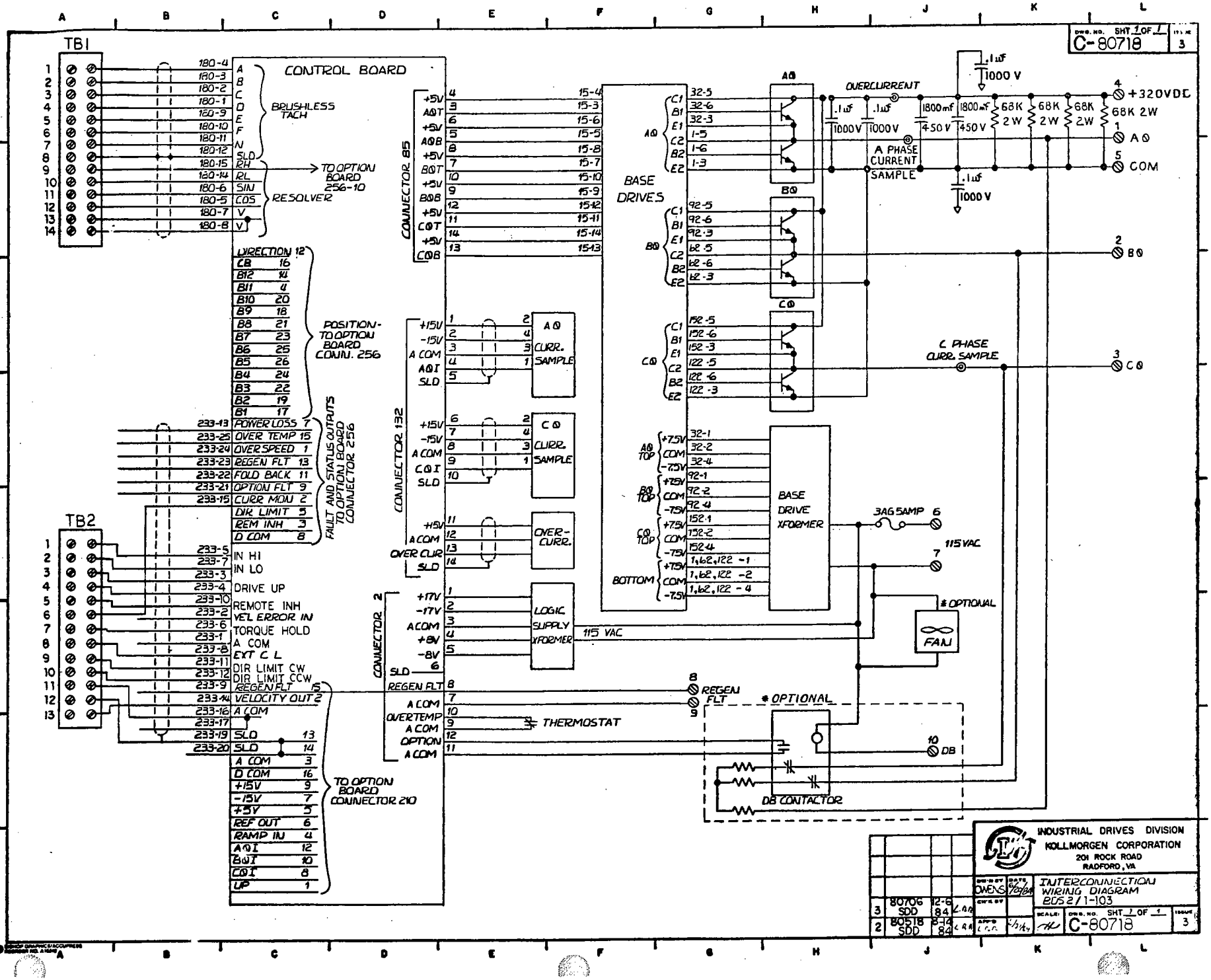
③ NORMALLY CLOSED CONTACTS, RATED 15V, 5MA. OPEN FOR DESIGNATED FUNCTION. EX: OPEN FOR REMOTE INHIBIT.

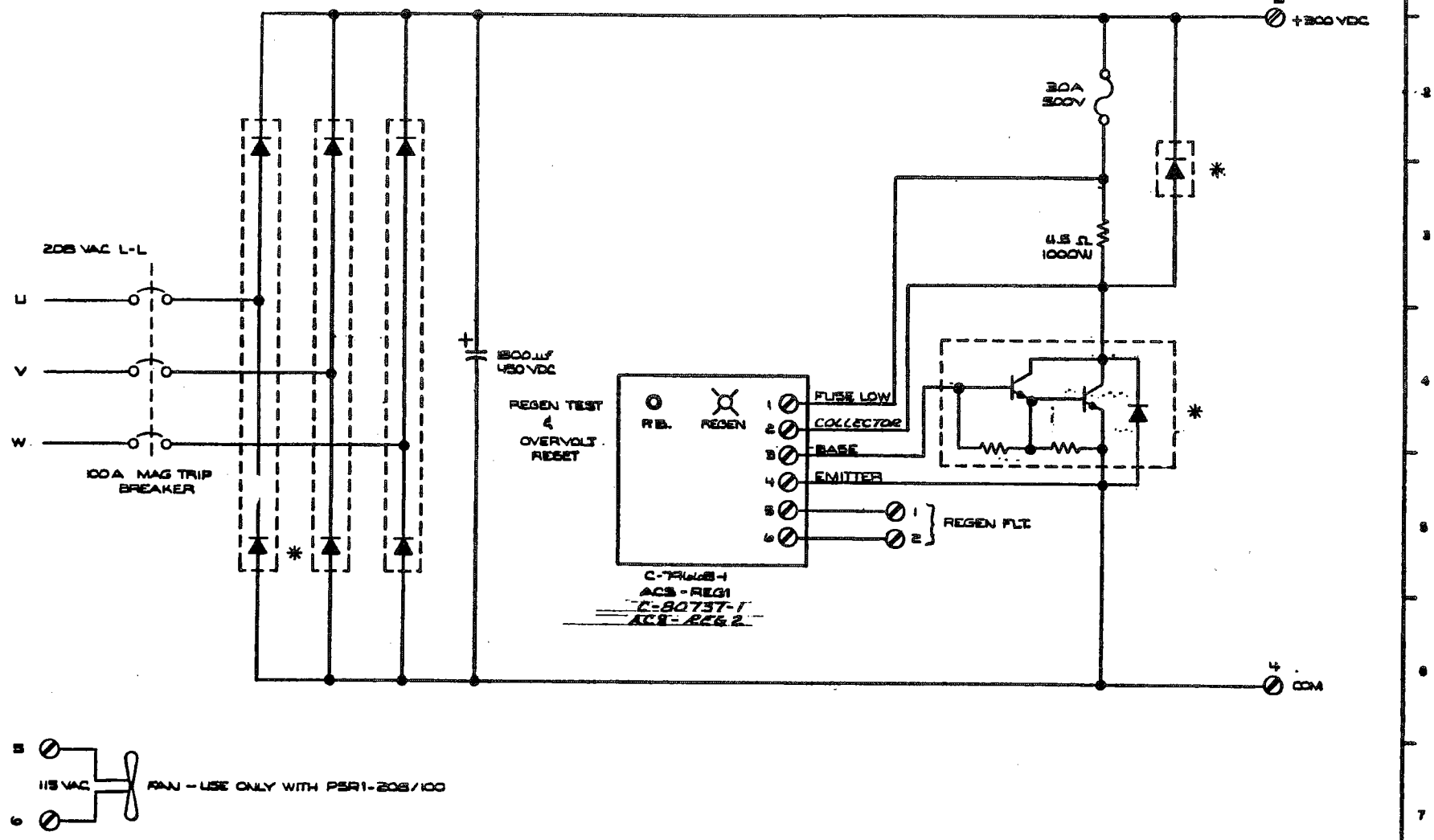
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA

4	80706 500	12-84	L.S.	OWENS	12/84
3	ECN 84 LLS	10-30-84	RB		
2	80518 500	8-14-84	L.S.		

SYSTEM WIRING DIAGRAM
BDS2/1-103

SCALE: — DWG. NO. C-80716 SHT 1 OF 1 ISSUE 4


TB1
CONTROL BOARD
BRUSHLESS TACH
RESOLVER
TO OPTION BOARD 256-10
POSITION-TO OPTION BOARD CONN. 256
FAULT AND STATUS OUTPUTS TO OPTION BOARD CONNECTOR 256
TB2
CONNECTOR 85
CONNECTOR 132
CONNECTOR 2
TO OPTION BOARD CONNECTOR 210
BASE DRIVES
BASE DRIVE XFORMER
OVERCURRENT
A PHASE CURRENT SAMPLE
C PHASE CURR. SAMPLE
+320VDC
A Ø
B Ø
C Ø
COM
3AG SAMP
115VAC
LOGIC SUPPLY XFORMER
115 VAC
FAN
* OPTIONAL
REGEN FLT
THERMOSTAT
DB
DB CONTACTOR
A Ø CURR. SAMPLE
B Ø CURR. SAMPLE
C Ø CURR. SAMPLE
OVER-CURR.
DRIVE UP
REMOTE INH
VEL ERROR IN
TORQUE HOLD
A COM
EXT C L
DIR LIMIT CW
DIR LIMIT CCW
VELOCITY OUT 2
OVERTEMP
OPTION
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA
INTERCONNECTION WIRING DIAGRAM
EDS 2/1-103
C-80718



* BROKEN LINE INDICATES MOUNTED ON HEAT SINK

3	REV-ADDED J. KRUSE 9/14/92	GP			
2	ADDED L-SNUBBER	5/26/88	LAA	1/2/88	

INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA

DRAWN DIRCO 8/2/88

SCHEMATIC
PSR1-208/100 & -208/040

SCALE | SHT 1 OF 1 | C- 79924 | 3

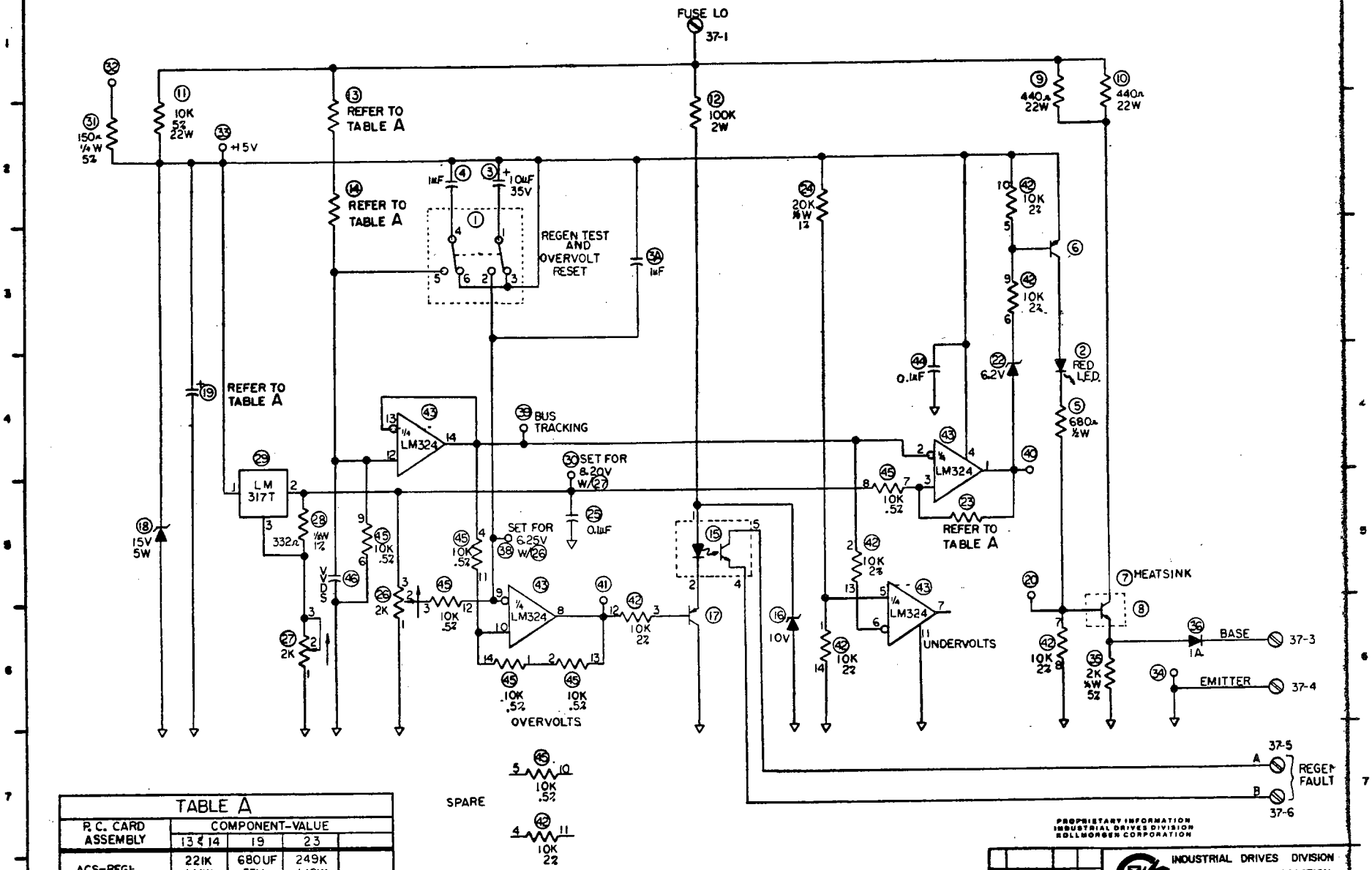


TABLE A

P.C. CARD ASSEMBLY	COMPONENT-VALUE 13 & 14	19	23	
ACS-REGI	221K 1/4W	680UF 35V	249K 1/8W	
ACS-REGI-160	100K 1/4W	10UF 35V	221K 1/8W	
ACS-REGI-225	162K 1/4W	10UF 35V	221K 1/8W	

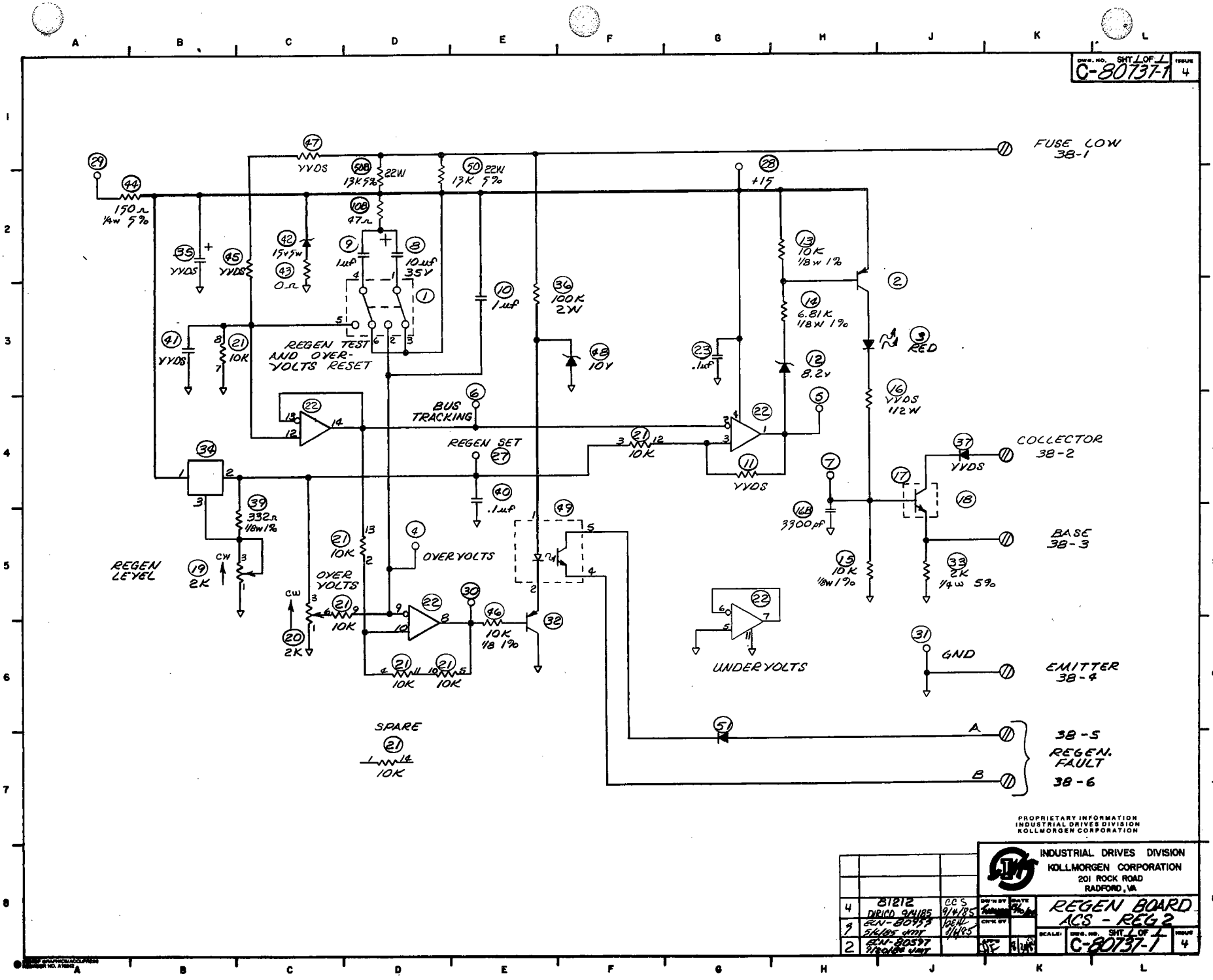
PROPRIETARY INFORMATION
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION

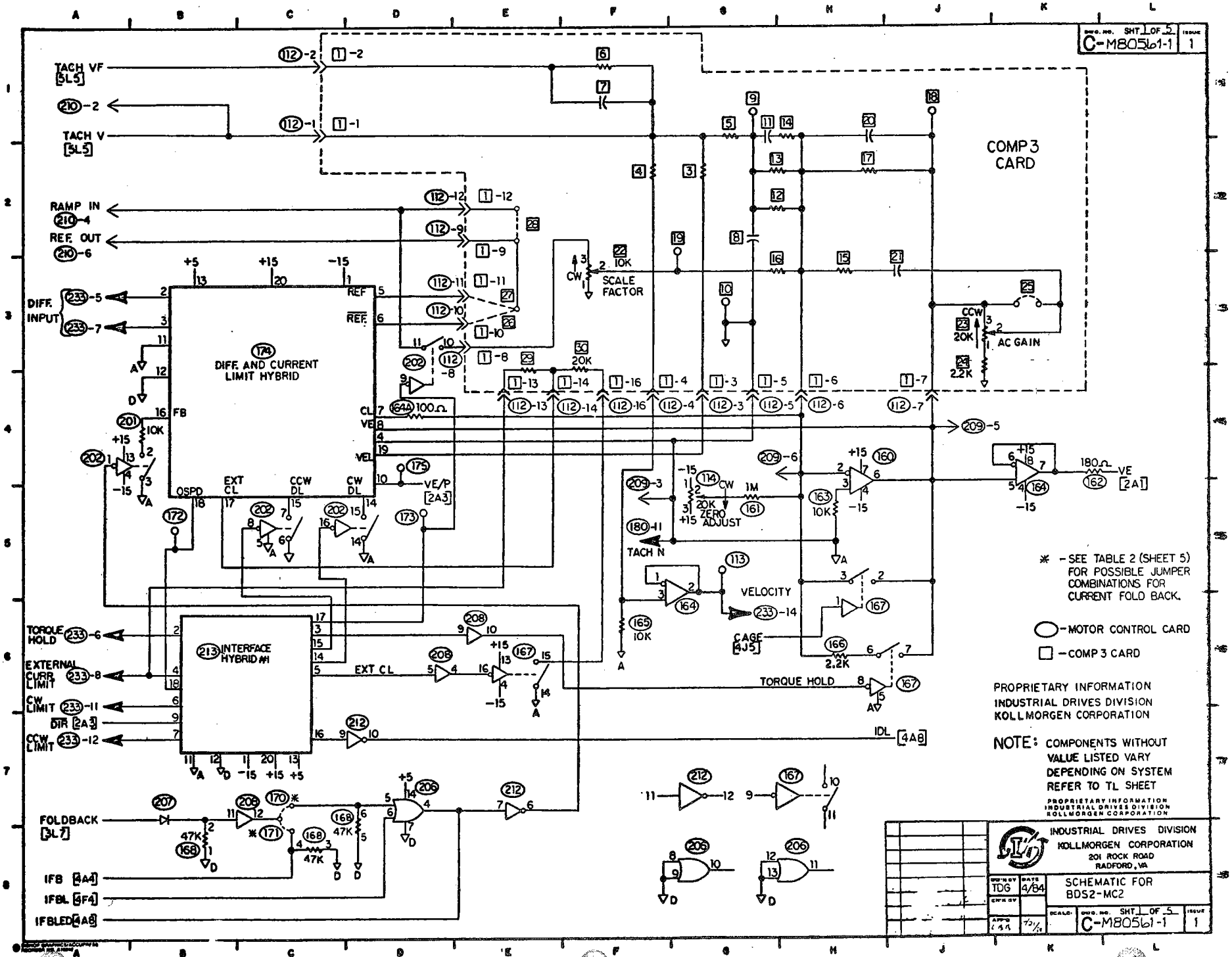
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA

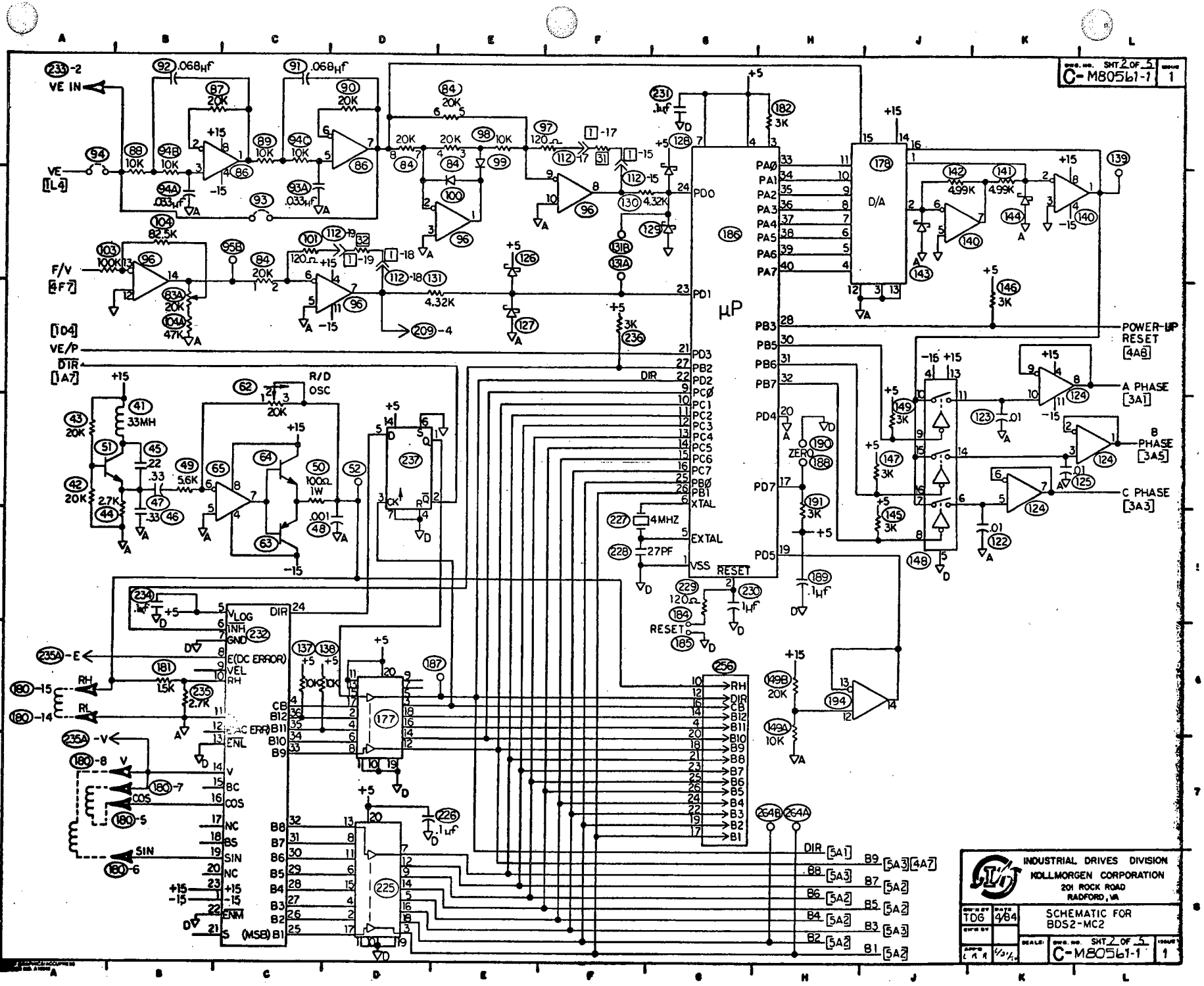
4	80572	9/10/84	
3	80471 SDD	7/25/84	
2	80298 SDD	4/16/84	

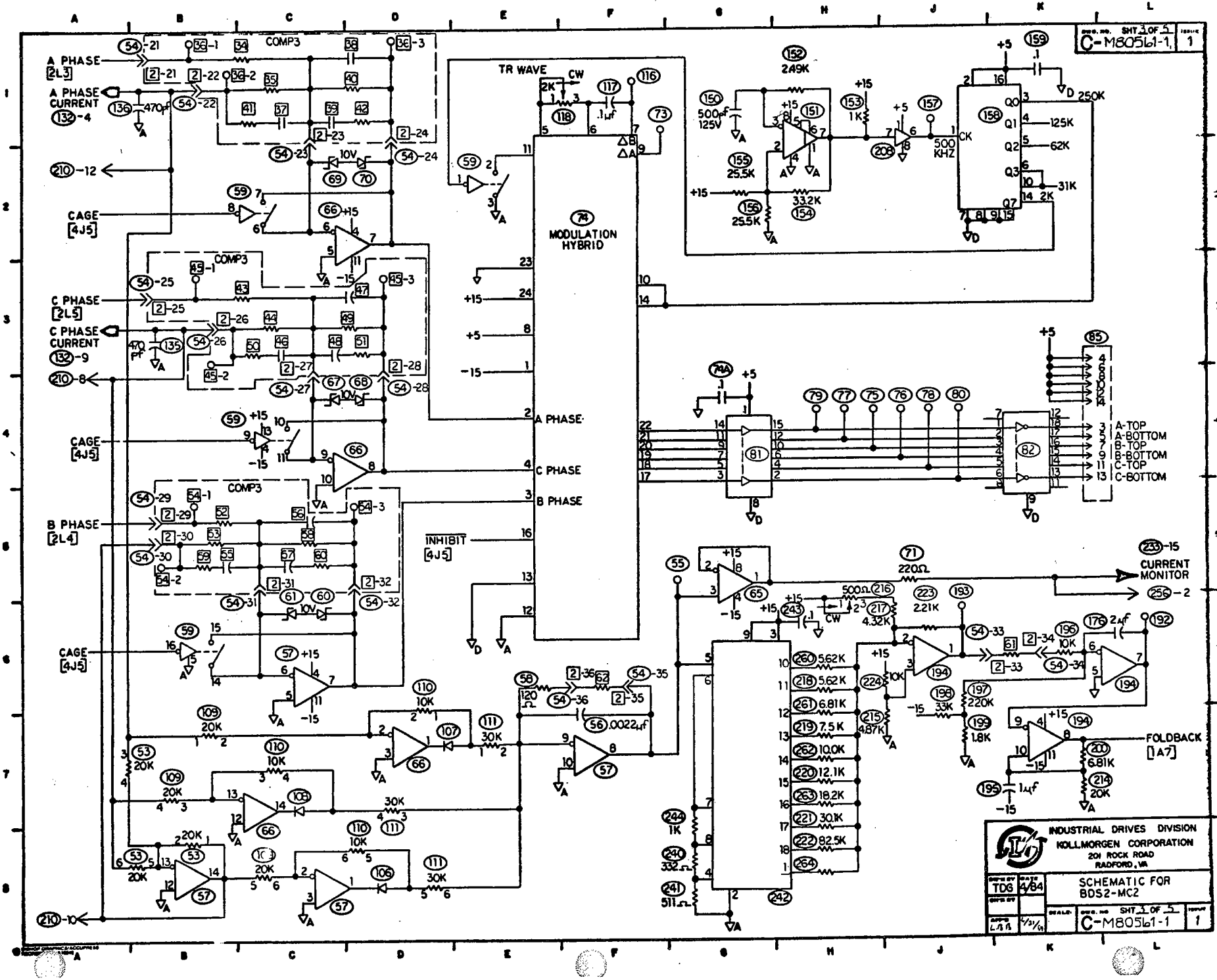
REGEN BOARD SCHEMATIC

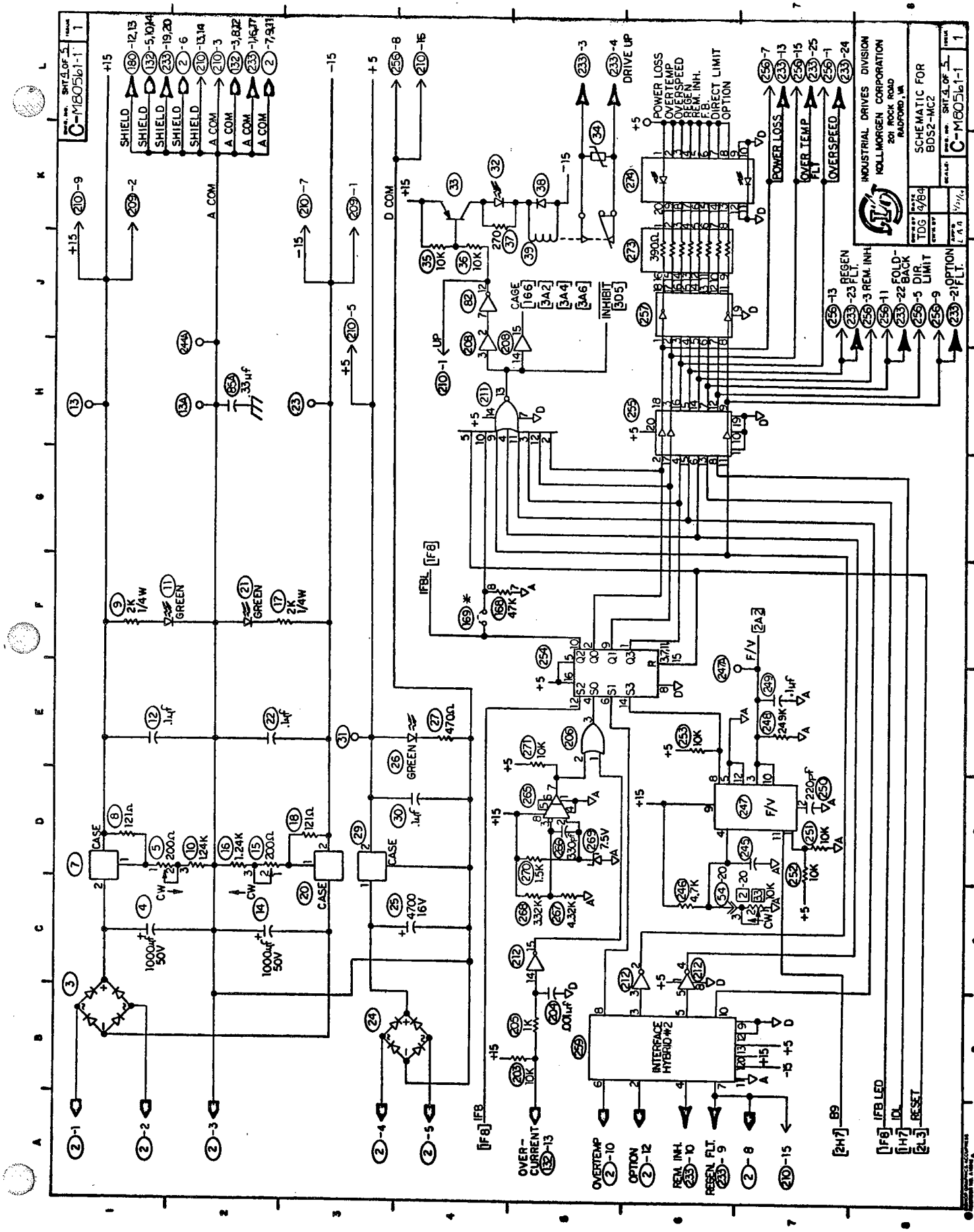
SCALE: / DWG. NO. C-79668-1 SHT 1 OF 1 ISSUE 4


DWG. NO. C-80737-1 SHT 1 OF 1 ISSUE 4
FUSE LOW 38-1
+15
150Ω 1/4W 5%
47 YYDS
48 13K 5% 22W
50 13K 5% 22W
108 47Ω
42 15Ω 5W
43 0Ω
9 1μF
8 10μF 35V
1
10 1μF
36 100K 2W
49 10V
35 YYDS
45 YYDS
41 YYDS
21 10K
REGEN TEST AND OVER-VOLTS RESET
6 BUS TRACKING
REGEN SET
27
40 .1μF
34
39 332Ω 1/8W 1%
REGEN LEVEL
19 2K
CW
20 2K
21 10K
OVER VOLTS
4 OVER VOLTS
30
46 10K 1/8 1%
32
21 10K
21 10K
SPARE
21 10K
49
51
13 10K 1/8W 1%
2
14 6.81K 1/8W 1%
3 RED
12 8.2V
23 .1μF
16 YYDS 1/2W
5
7
18 3300pF
15 10K 1/8W 1%
11 YYDS
17
18
33 2K 1/4W 5%
37 YYDS
COLLECTOR 38-2
BASE 38-3
UNDERVOLTS
31 GND
EMITTER 38-4
A
B
38-5 REGEN. FAULT
38-6
PROPRIETARY INFORMATION
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA
4 81212 DIRICD 9/4/85 CCS 9/4/85
3 EN-80973 5/6/85 dmt 10/8/85 9/4/85
2 EN-80597 9/20/85 dmt
REGEN BOARD ACS-REG2
SCALE: DWG. NO. C-80737-1 SHT 1 OF 1 ISSUE 4


DWG. NO. C-M80561-1 SHT 1 OF 5 ISSUE 1
COMP 3 CARD
TACH VF [5L5]
TACH V [5L5]
RAMP IN
REF. OUT
DIFF. INPUT
DIFF. AND CURRENT LIMIT HYBRID
SCALE FACTOR
AC GAIN
ZERO ADJUST
TACH N
VELOCITY
CAGE [4J5]
TORQUE HOLD
EXTERNAL CURR. LIMIT
CW LIMIT
CCW LIMIT
INTERFACE HYBRID #1
FOLDBACK [3L7]
IFB [4A4]
IFBL [4F4]
IFBLED [4A8]
IDL [4A8]
VE/P [2A3]
VE [2A1]
* - SEE TABLE 2 (SHEET 5) FOR POSSIBLE JUMPER COMBINATIONS FOR CURRENT FOLD BACK.
- MOTOR CONTROL CARD
- COMP 3 CARD
PROPRIETARY INFORMATION
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
NOTE: COMPONENTS WITHOUT VALUE LISTED VARY DEPENDING ON SYSTEM REFER TO TL SHEET
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA
SCHEMATIC FOR
BDS2-MC2
TDG 4/84
C-M80561-1 SHT 1 OF 5 ISSUE 1


C-M80561-1 SHT 2 OF 5
VE IN
VE
[L4]
F/V
[F7]
[D4]
VE/P
DIR
[A7]
R/D OSC
33MH
4MHZ
27PF
RESET
μP
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
D/A
PB3
POWER-UP RESET
[4A8]
PB5
PB6
PB7
PD4
PD7
PD5
ZERO
A PHASE
[3A1]
B PHASE
[3A5]
C PHASE
[3A3]
PD0
PD1
PD3
PB2
PD2
PC0
PC1
PC2
PC3
PC4
PC5
PC6
PC7
PB0
PB1
XTAL
EXTAL
VSS
VLOG
INH
GND
E(DC ERROR)
VEL
RH
RL
DAC ERR
ENL
V
BC
COS
NC
BS
SIN
ENM
(MSB) B1
CB
B12
B11
B10
B9
B8
B7
B6
B5
B4
B3
B2
B1
DIR [5A1]
B9 [5A3] [4A7]
B8 [5A3]
B7 [5A2]
B6 [5A2]
B5 [5A2]
B4 [5A2]
B3 [5A3]
B2 [5A2]
B1 [5A2]
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA
TDG
484
SCHEMATIC FOR
BDS2-MC2
C-M80561-1 SHT 2 OF 5


A PHASE [2L3]
A PHASE CURRENT
C PHASE [2L5]
C PHASE CURRENT
B PHASE [2L4]
CAGE [4J5]
INHIBIT [4J5]
COMP3
TR WAVE
MODULATION HYBRID
A PHASE
C PHASE
B PHASE
249K
500 KHz
125K
62K
31K
A-TOP
A-BOTTOM
B-TOP
B-BOTTOM
C-TOP
C-BOTTOM
CURRENT MONITOR
FOLDBACK [1A7]
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA
SCHEMATIC FOR
BDS2-MC2
C-M80561-1
SHT 3 OF 5
ISSUE 1


INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA
SCHEMATIC FOR
BDS2-MC2
C-M80561-1
SHT 4 OF 5
TDG
4/84
+15
-15
+5
A COM
D COM
SHIELD
CASE
GREEN
POWER LOSS
OVERTEMP
OVERSPEED
REGEN
REM. INH.
F.B.
DIRECT LIMIT
OPTION
DRIVE UP
POWER LOSS
OVER TEMP FLT
OVERSPEED
REGEN FLT.
-3 REM. INH.
FOLD-BACK
DIR. LIMIT
OPTION FLT.
CAGE
INHIBIT
IFBL
IFB
OVER-CURRENT
OVERTEMP
OPTION
REM. INH.
REGEN. FLT.
INTERFACE HYBRID #2
F/V
IFB LED
IOL
RESET

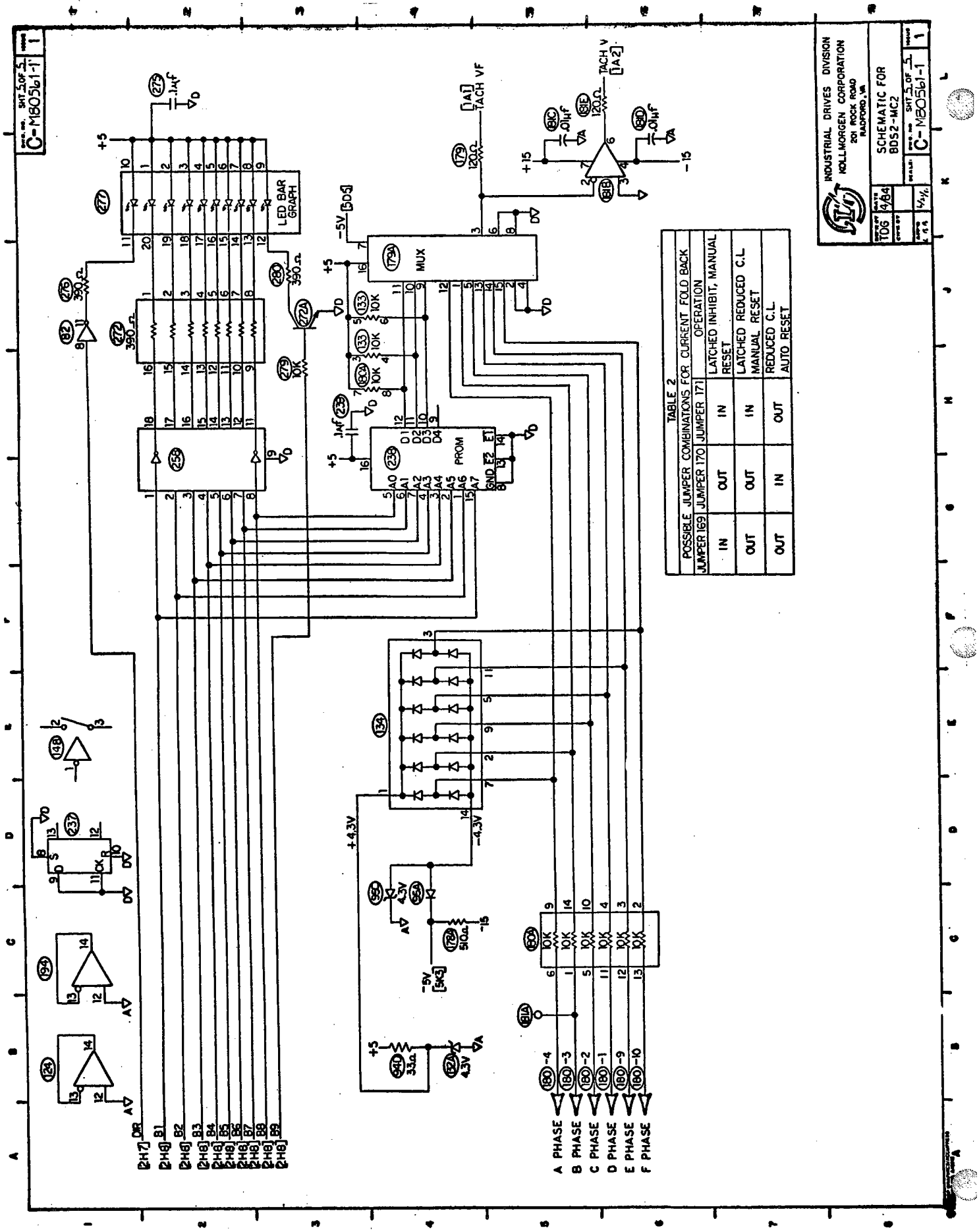
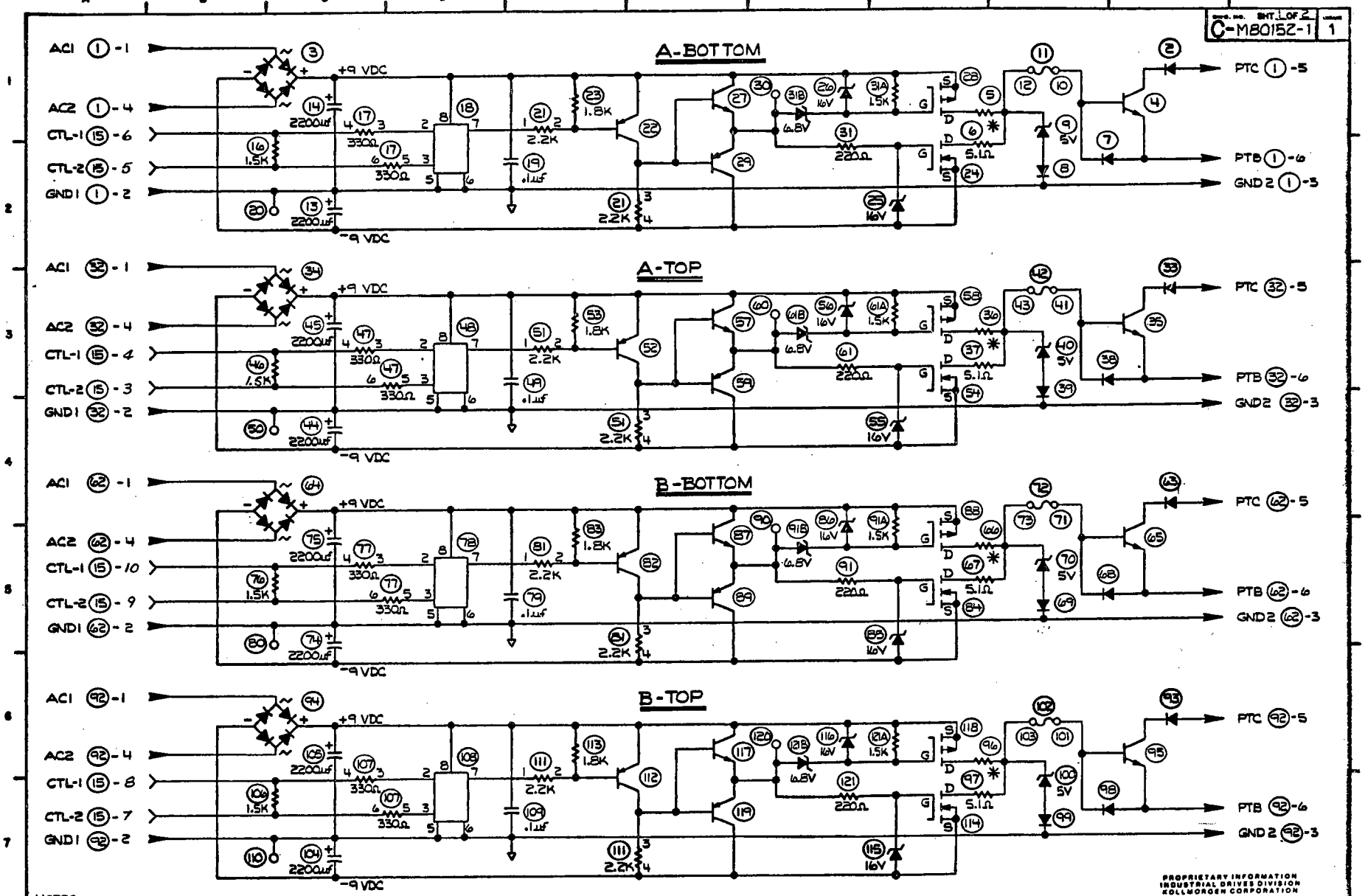


TABLE 2

POSSIBLE JUMPER COMBINATIONS FOR CURRENT FOLD BACK			
JUMPER 169	JUMPER 170	JUMPER 171	OPERATION
IN	OUT	IN	LATCHED INHIBIT, MANUAL RESET
OUT	OUT	IN	LATCHED REDUCED C.L MANUAL RESET
OUT	IN	OUT	REDUCED C.L AUTO RESET



NOTES:

① * VALUE VARIES DEPENDING ON SYSTEM.

COMPONENTS	AMP	BILL OF MATERIAL	VALUE
5, 36, 66 96, 126, 163	25	BDS2-BDI-01	47Ω 5W
	40	BDS2-BDI-02	30Ω 5W
	60	BDS2-BDI-03	27Ω 5W

SPARES

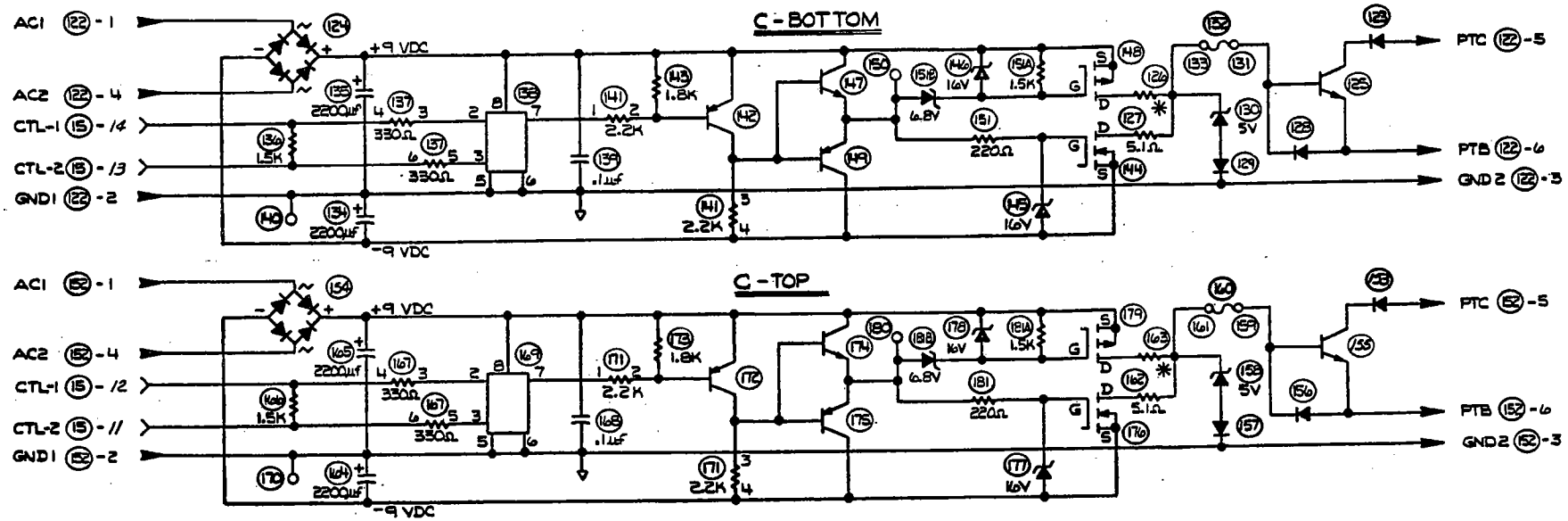
A		B	
(17) 330Ω	(21) 2.2K	(77) 330Ω	(81) 2.2K
(47) 330Ω	(51) 2.2K	(107) 330Ω	(111) 2.2K

PROPRIETARY INFORMATION
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION

INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA

SCHEMATIC
BDS2-BDI

DWG. NO. C-M80152-1 SHT 1 OF 2 REV 1



SPARES C

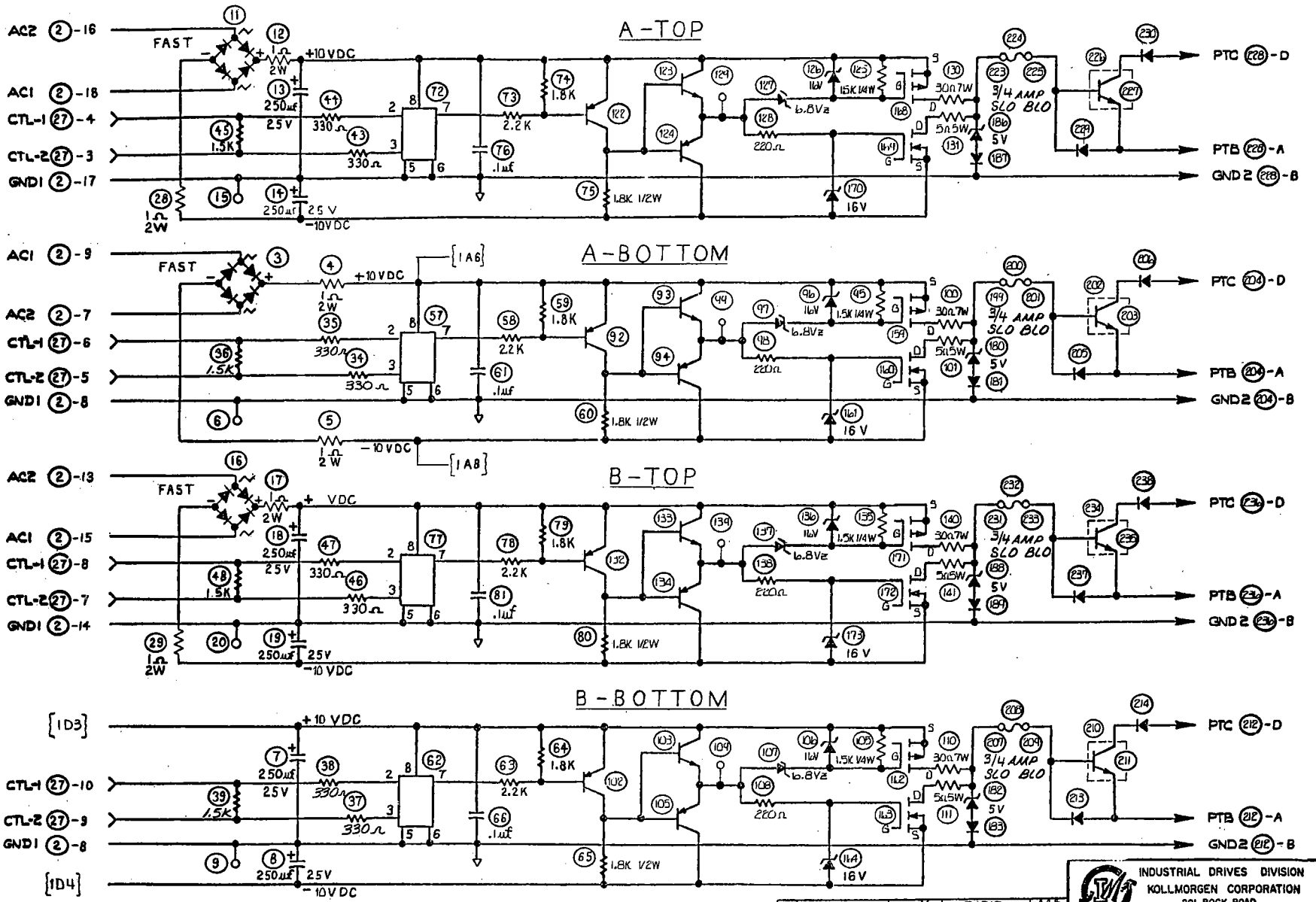
(137) 330Ω (141) 2.2K

(167) 330Ω (171) 2.2K

INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA

SCHEMATIC
BDS2-BDI

DWG. NO. C-M80152-1 SHT 2 OF 2 ISSUE 1



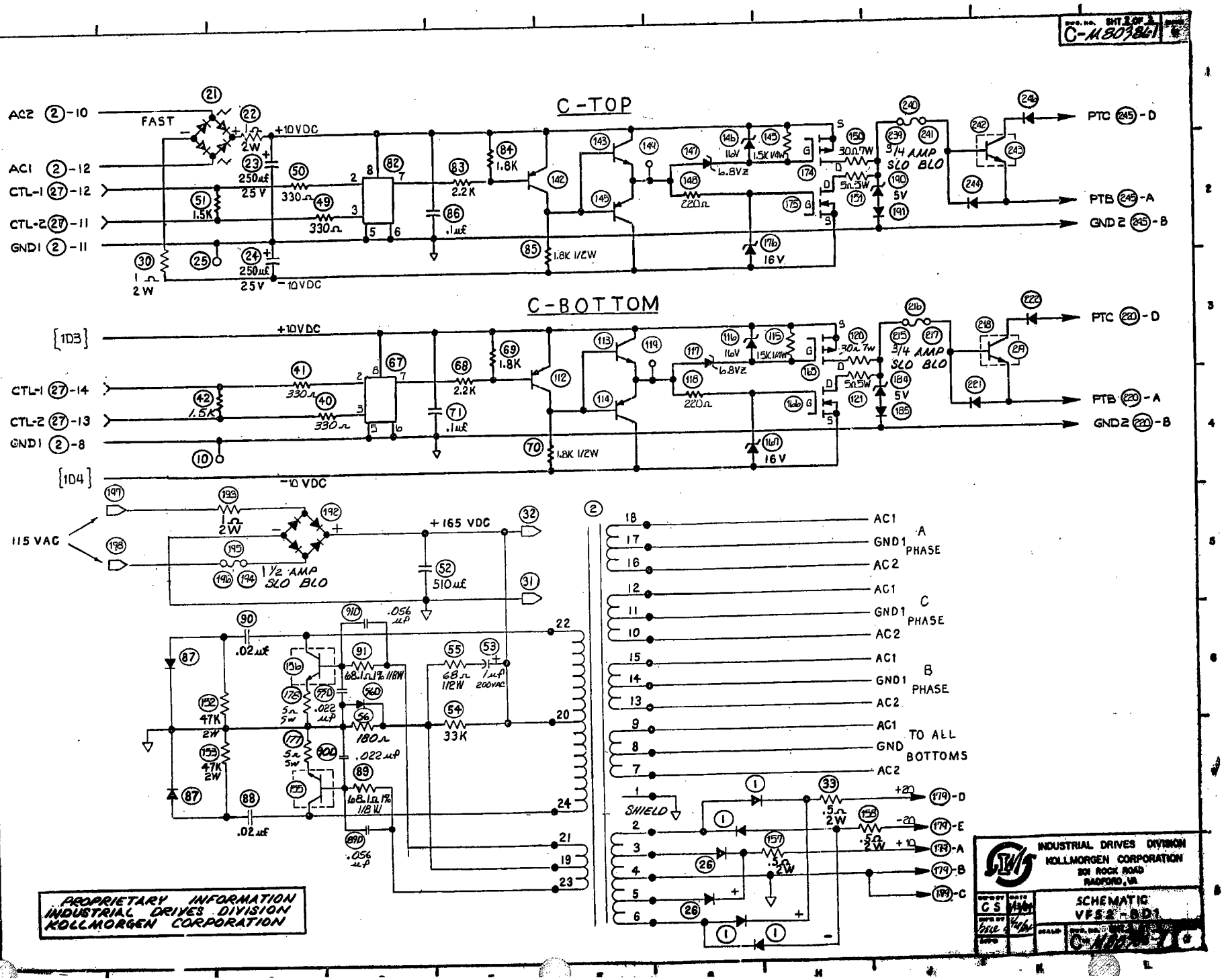
PROPRIETARY INFORMATION
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION

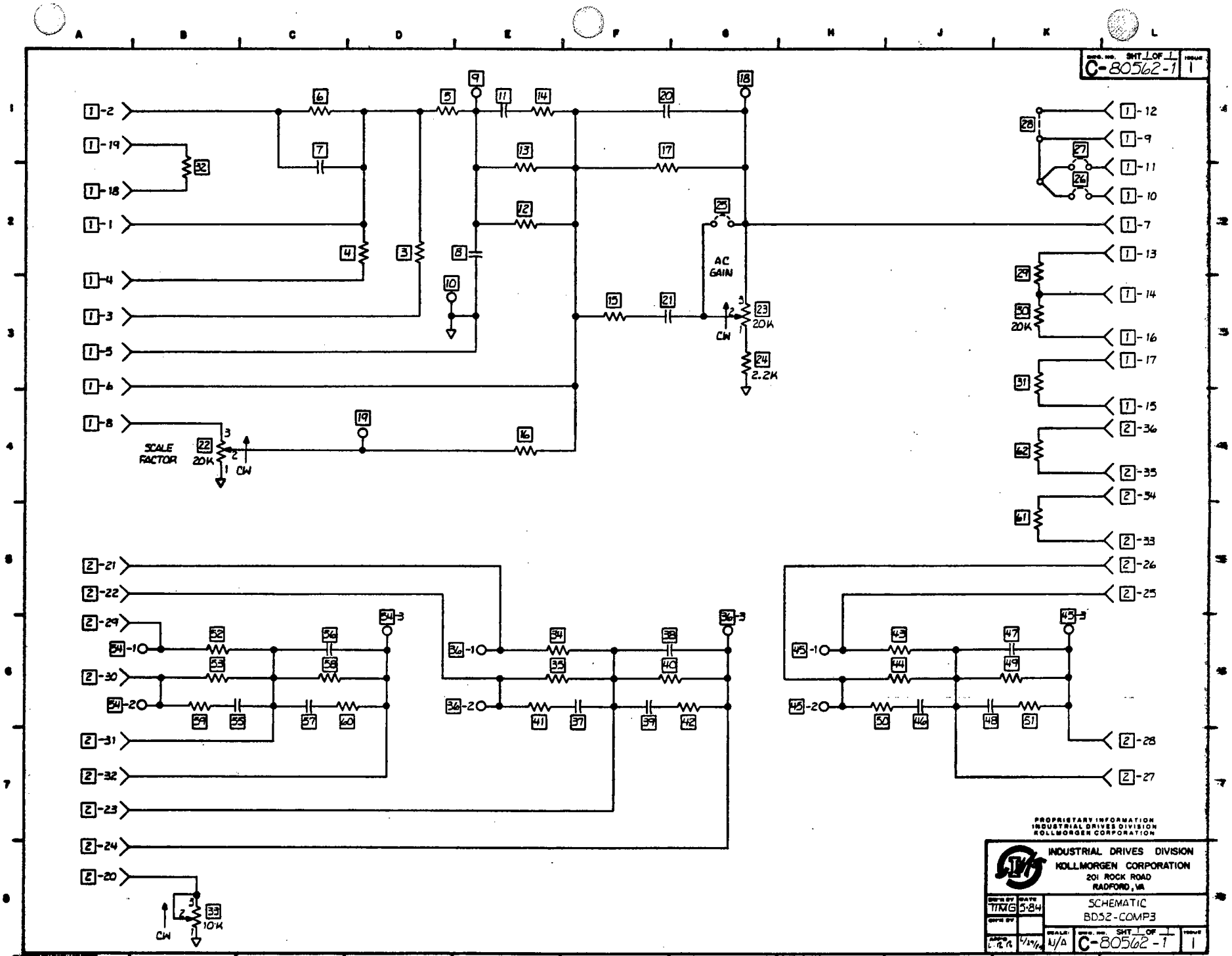
			5	B1212 DIRCO 9/4/85	C.S.	9/4/85
			4	B1184 DIRCO 8-23-85	C.S.	9/27/85
			3	ECN-81133 8-6-85 JMT		
			2	ECN-80482 7-31-85 JMT		
6	B1380 DIRCO 8/19/85					

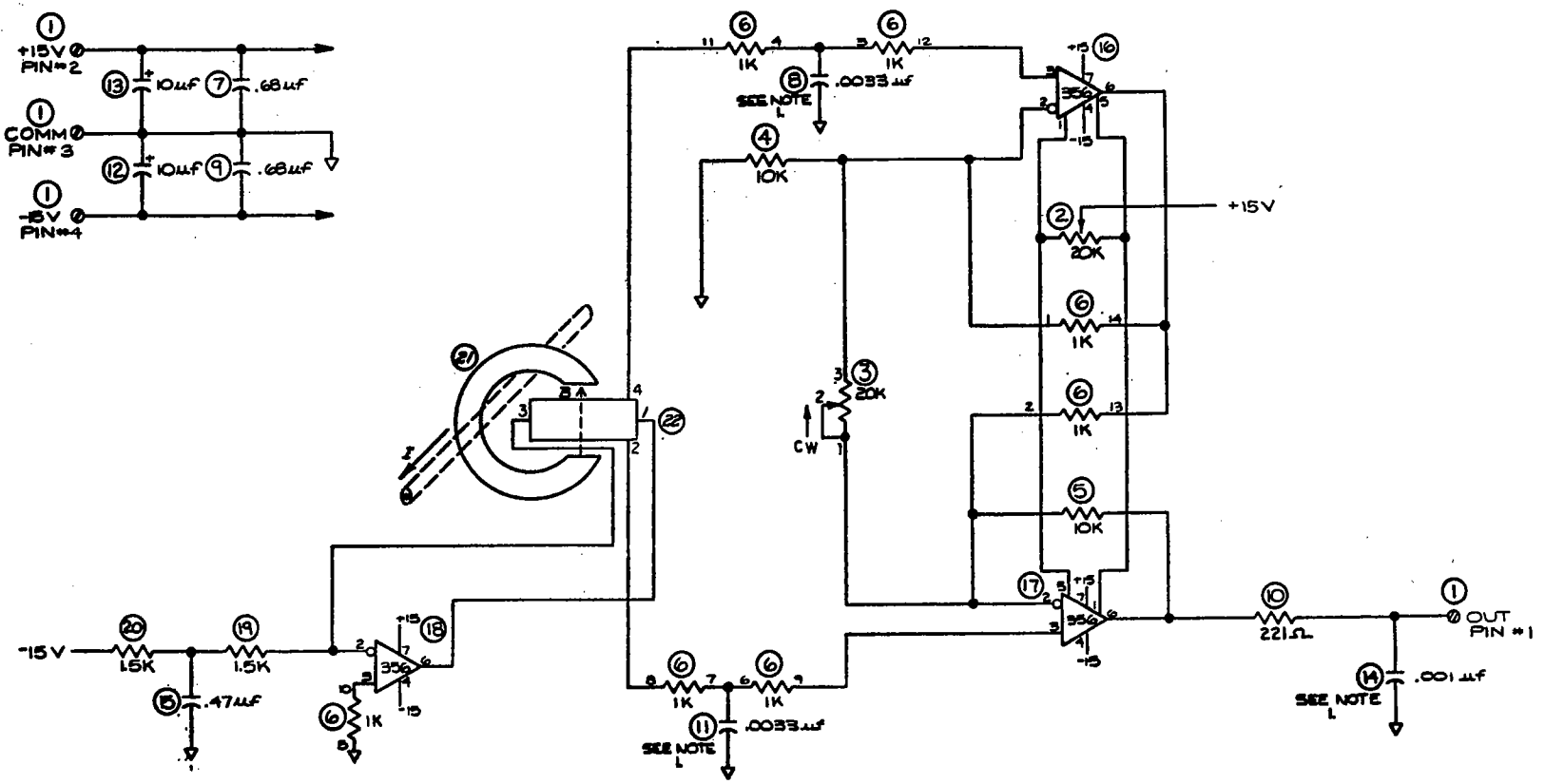
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA

SCHEMATIC
VF52-BD1

DWN BY C.S. 1/13/84
CHK'D BY 1/28/84
APP'D 1/31/84
SCALE:
DWG. NO. C-M80386-1 SHT. 1 OF 2 ISSUE 6


C-TOP
C-BOTTOM
AC2 (2)-10
AC1 (2)-12
CTL-1 (27)-12
CTL-2 (27)-11
GND1 (2)-11
FAST
+10VDC
-10VDC
PTC (245)-D
PTB (245)-A
GND2 (245)-B
PTC (220)-D
PTB (220)-A
GND2 (220)-B
CTL-1 (27)-14
CTL-2 (27)-13
GND1 (2)-8
115 VAC
+165 VDC
-10 VDC
3/4 AMP SLO BLO
1 1/2 AMP SLO BLO
AC1 A PHASE
GND1
AC2
AC1 C PHASE
GND1
AC2
AC1 B PHASE
GND1
AC2
AC1 TO ALL BOTTOMS
GND
AC2
SHIELD
PROPRIETARY INFORMATION
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
801 ROCK ROAD
RADFORD, VA
SCHEMATIC
VFS2-BD1
C-M803861


C-80562-1
1-2
1-19
1-18
1-1
1-4
1-3
1-5
1-6
1-8
SCALE FACTOR
22
20K
CW
AC GAIN
23
20K
24
2.2K
1-12
1-9
1-11
1-10
1-7
1-13
1-14
1-16
1-17
1-15
2-36
2-35
2-34
2-33
2-26
2-25
2-28
2-27
2-21
2-22
2-29
2-30
2-31
2-32
2-23
2-24
2-20
33
10K
CW
PROPRIETARY INFORMATION
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION
201 ROCK ROAD
RADFORD, VA
TMG
5-84
SCHEMATIC
BD52-COMP3
N/A
C-80562-1



NOTE:
1. CAPACITORS 8, 11 & 14 ARE NOT USED IN A 350 AMP UNIT

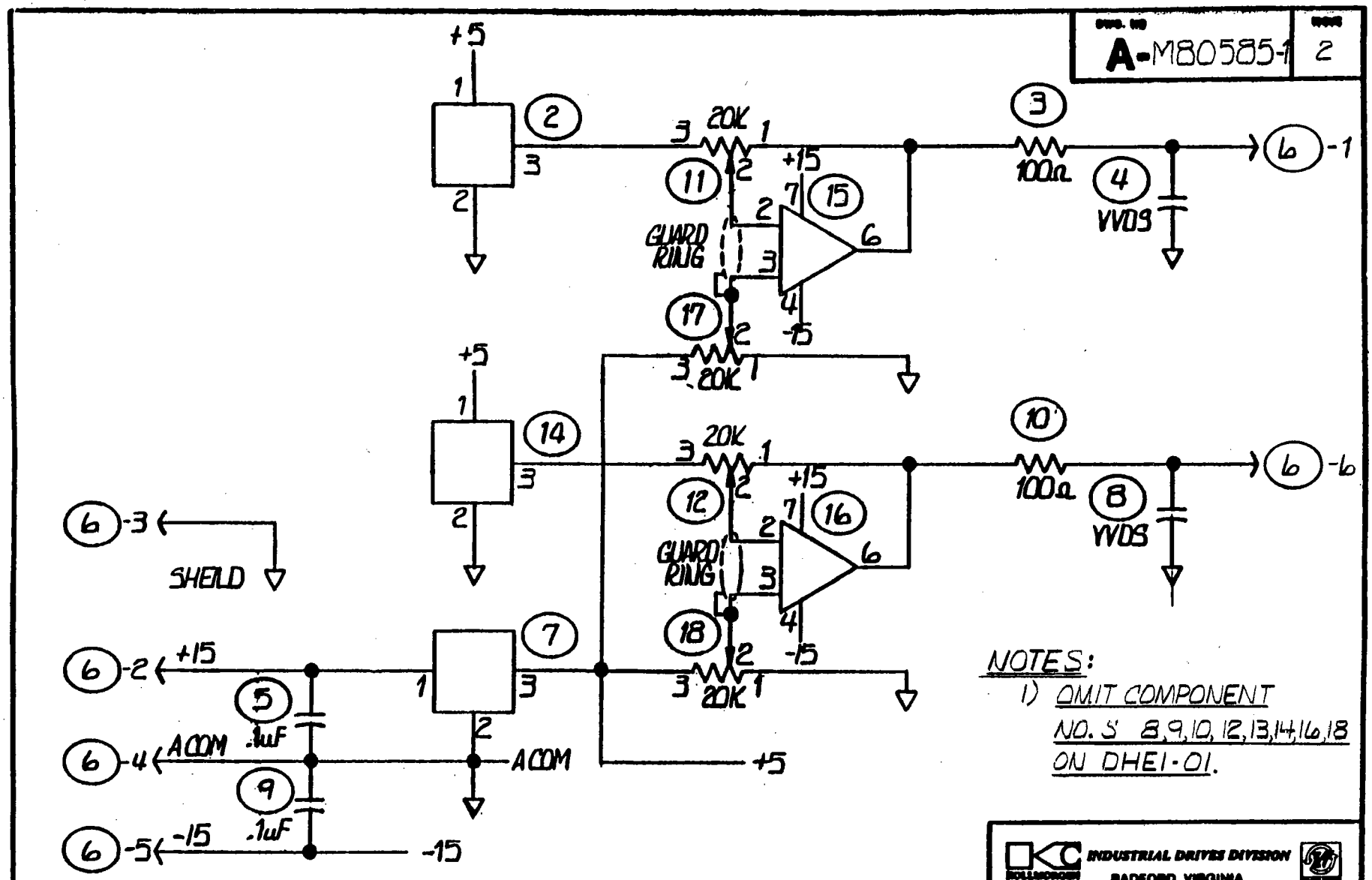
PROPRIETARY INFORMATION
INDUSTRIAL DRIVES DIVISION
KOLLMORGEN CORPORATION

INLAND MOTOR
INDUSTRIAL DRIVE DIVISION
KOLLMORGEN CORPORATION

HALL EFFECT CURRENT SAMPLER FOR HECS -250/350

DRAWN BY	DATE
MLW	12/81
	11/1/82
	11/1/82

SCALE: N.T.S. DWG. NO. C-M79087-1 ISSUE 1


DWG. NO. A-M80585-1
ISSUE 2
+5
1
2
3
2
3
20K
1
2
11
+15
7
15
2
GUARD RING
6
3
4
-15
17
2
3
20K
1
100Ω
4
VVDS
6-1
+5
1
14
3
2
3
20K
1
2
12
+15
7
16
2
GUARD RING
6
3
4
-15
18
2
3
20K
1
10
100Ω
8
VVDS
6-6
6-3
SHEILD
6-2
+15
5
.1uF
6-4
ACOM
9
.1uF
6-5
-15
1
7
3
2
ACOM
-15
+5
NOTES:
1) OMIT COMPONENT NO.'S 8,9,10,12,13,14,16,18 ON DHEI-01.
UNLESS OTHERWISE SPECIFIED
XX DEC. PLACES ±.010
XXX DEC. PLACES ±.005
ANG. DIM. ±1°
DO NOT SCALE DWG. USE DIMENSIONS ONLY
ALL DIMENSIONS ARE INCHES
UNLESS OTHERWISE SPECIFIED
NO. | SCH NO. | DATE | APP'D.
2 | 81380 DIRICO | 12/12/85
DW'N BY LLS | DATE 3/29
CH'K BY
APP'D BY CJF | 5/15/84
KC INDUSTRIAL DRIVES DIVISION
RADFORD, VIRGINIA
SCHEMATIC
DHEI AND DHEI-01
SCALE: X
DWG. NO. A-M80585-1
ISSUE 2